Bfd.
5

THE JOURNAL OF INDUSTRIAL HYGIENE

EDITORS

DAVID L. EDSALL, M.D., S.D., United States
A. F. STANLEY KENT, A.M., D.Sc., Great Britain

VOLUME II

MAY, 1920—APRIL, 1921

PUBLISHERS

HARVARD UNIVERSITY PRESS

1 Divinity Avenue, Cambridge, Mass.

CONTENTS OF VOLUME II

MAY, 1920. NUMBER 1

JUNE, 1920. NUMBER 2

JULY, 1920. NUMBER 3

AUGUST, 1920. NUMBER 4

SEPTEMBER, 1920. NUMBER 5

OCTOBER, 1920. NUMBER 6

NOVEMBER, 1920. NUMBER 7

DECEMBER, 1920. NUMBER 8

JANUARY, 1921. NUMBER 9

FEBRUARY, 1921. NUMBER 10

MARCH, 1921. NUMBER 11

APRIL, 1921. NUMBER 12

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

Volume II | MAY, 1920 | Number 1

THE MORTALITY FROM RESPIRATORY DISEASES IN THE GLASS INDUSTRY*

FREDERICK L. HOFFMAN, LL.D.

Third Vice-President and Statistician, The Prudential Insurance Company of America, Newark, N. J.

GLASSWORKERS are employed in what is notoriously an unhealthy occupation, but it is quite erroneous to classify all glassworkers alike and to apply this description to the industry as a whole. Furthermore, earlier conclusions must be materially modified in the light of subsequent experience, for what was true thirty years ago is today but in part applicable to a relatively small group of men employed in particularly hazardous occupations. The latest census data give the number of persons employed in the glass industry as 78,804, of which 74,502 are wage-earners, or about 6,000 more than five years earlier at the time of the census of 1909. The increase in the number of wage-earners in the glass industry has not been as rapid as the growth of the industry in other respects, largely because of the modern tendency to substitute mechanical devices for human labor wherever that is possible. A further and even more important reason for the relatively slow increase in the number of persons employed is the replacement of old-style pot furnaces by more modern tank furnaces, which employ, in proportion to the product, a relatively smaller number of men.

The glass industry, broadly speaking, is divided into (1) plate glass, which includes window glass, plate glass, and all varieties of cast and roll glass; (2) pressed and blown glass, such as table ware, glasses and tumblers, lamp chimneys, globes, etc.; (3) cut glass; and (4) bottles, jars, demijohns, etc. Each of these major branches has its own peculiar health hazards or its own conditions which more or less safeguard or predispose for or against disease liability, particularly the mortality from tuberculosis and respiratory diseases. It does not fall within the province of this discussion to present, even in outline, a descriptive account of the numerous glass-making processes, though it may be said that there is a regrettable absence of technical works useful for the purpose of gaining an accurate understanding of the health hazards in their relation to highly specialized processes. The earlier works of reference which are generally relied upon are no longer applicable to the purpose, for a modern glassworks, although conforming in some respects to the industry as it has been carried on for ages, is nevertheless fundamentally differ-

* Address prepared for the Glass Division of the American Ceramic Society, Philadelphia, Feb. 24, 1920. Received for publication March 2, 1920

ent, at least as regards health and life, from the glassworks of the past.

A second and equally important consideration is the very material improvement in the quality of labor employed in the glass industry. Long before the advent of prohibition there had been a decided improvement in the habits of the men in the direction of a lesser liability to drunkenness or gross intoxication, which in itself is a predisposing cause to disease, particularly lead poisoning and tuberculosis.

Life insurance companies have at all times taken a serious view of this occupation; such investigations as have been made have almost invariably disclosed a higher mortality than that met with among the artisan element generally. Twenty years ago practically all glassworkers, or at least blowers and gatherers and men employed in the manufacture of cut glass, such as cutters, polishers and pressers, were either declined or charged extra premium rates, practically prohibitive. By 1903 rates had generally improved, although even now (in 1920) they are still excessive for some employments and, for some occupations, prohibitive because of the probably continued existence of conditions inimical to health and life. These conditions apply particularly to mixers and handlers of materials on account of the exposure to mineral dust, the mechanical and chemical properties of which unquestionably predispose to silicosis and a resulting true pulmonary tuberculosis. Comparing 1903, however, with 1919, it will be sufficient for the present purpose to give the extra premium charges on a whole life policy for $1,000 at age 35. These charges have nearly all been modified for the better — so much so that while in most occupations higher charges continue to be made they are now easily borne, considering the advantages gained by life-insurance protection on the legal reserve plan. A blower, for illustration, would have been declined entirely in 1900, but was accepted in 1903 at intermediate rates, or say $5.91 extra per $1,000. By 1919 intermediate rates had been reduced to special rates, or $2.77 extra per $1,000. A batch wheeler, acceptable at intermediate rates in 1903, was accepted at medium rates in 1919, or at a reduction of from $5.91 to $5.67 extra per $1,000. Occupations such as mixers and handlers of material continue to be declined; but in plate-glass making bevelers, formerly charged special rates, or $3.16 extra per $1,000, are now accepted without rating.

Perhaps the most important changes have been made in the case of the glass-cutting industry which was formerly considered particularly hazardous on account of the liability to lead poisoning — a liability which has, however, been practically done away with. Glass cutters and polishers in 1900 were charged an extra premium of $6.35 per $1,000 on the intermediate plan and $5.92 in 1908, but they are now accepted without rating. Roughers and smoothers, who were formerly charged intermediate rates, or $5.92 extra per $1,000, are now accepted without rating. Only puttyers continue to be declined, but it is quite probable that further investigations may disclose that earlier hazards of dampness, liability to lead poisoning, and dust have largely been done away with. It may at first seem that the dust hazard in wet polishing should be negligible, but the difficulty is that a large amount of dust accumulates about the shop as the result of drying, contaminates the atmosphere, and predisposes to dust phthisis.

The reduction of insurance rates is gratifying evidence of the sanitary progress in the glass industry, and suggests the desirability of a much more thorough investigation than has thus far been made into a subject of special interest to all who are concerned with the larger problem of pneumonoconiosis and dust phthisis. The evidence, however, is entirely conclusive that the

general mortality from pulmonary tuberculosis continues to be excessive among glassworkers as a group, and particularly among glass blowers separately considered, as well as among glass polishers.

The statistical evidence on this question is quite convincing. According to the industrial mortality experience of the Prudential, glassworkers during the period 1914–1918 experienced a proportionate mortality from pulmonary tuberculosis equivalent to 26.3 per cent. of the mortality from all causes, which compares with 12.3 per cent. for the practically corresponding period of the registration area. This excess, however, shows a diminution from 31.8 per cent. for the earlier period of 1897–1914, and particularly so at the important age period 25 to 34. Considering glass blowers only, it appears that the proportionate mortality from pulmonary tuberculosis was 32.1 per cent. during the period 1897–1914, and that by 1914–1918 this had diminished to 25.9 per cent. The mortality at the age period 25 to 34 diminished from 53.3 per cent. during the earlier period to 39.7 per cent. at the present time, but the excess even at the last-named period is clearly emphasized by the comparative figure for the registration area, which was only 29.5 per cent. It would seem, therefore, a safe conclusion that, while progress has been made in the direction of a diminishing mortality from pulmonary tuberculosis among glassworkers, the reduction has not been proportionately as large as the general progress in the prevention, treatment and control of the disease would seem to justify.

I had occasion to discuss this question, first, in my work on *Consumption in Dusty Trades,* published by the United States Bureau of Labor in November, 1908, and, second, in my *Mortality from Respiratory Diseases in Dusty Trades,* published by the same authority in June, 1918. On neither occasion could I enlarge upon the details of an industry which, as I have said before, has never been the subject of a really thoroughly qualified investigation. It may be recalled that in 1906 the president of the Glass Blowers' Association of America, Mr. Dennis A. Hays, read an interesting paper before the American Academy of Political and Social Science on the length of the trade life in the glass-bottle industry. Unfortunately this paper did not contain the statistical evidence which would have been useful in encouraging authorities on occupational diseases to give extended consideration to the subject; in fact, no one has as yet contributed the results of an extended statistical inquiry into the actual facts of mortality experience. Fragmentary references are to be found in *Diseases of Occupation* by Sir Thomas Oliver (page 377 *et seq.*) where attention is called to "the great amount of dust being blown about in the neighborhood of the furnaces," although this particular reference applies to injuries of the eyes. W. Gilman Thompson in his *Occupational Diseases* gives some interesting illustrations of actual processes, but brings forward no new data derived

TABLE 1. — PROPORTIONATE MORTALITY FROM PULMONARY TUBERCULOSIS AMONG GLASSWORKERS

(Industrial experience of Prudential Insurance Company, 1914–1918, compared with that of all males in the United States registration area, 1914–1917, by age groups.)

Age at Death	Deaths of Glassworkers 1914–1918 from		Per Cent. of Deaths from Pulmonary Tuberculosis among	
	All Causes	Pulmonary Tuberculosis	Glass-Workers	Males in Registration Area 1914–1917
15 to 24	136	36	26.5	26.0
25 to 34	212	82	38.7	29.5
35 to 44	148	52	35.1	22.6
45 to 54	117	27	23.1	13.8
55 to 64	124	14	11.3	7.3
65 and over ..	78	3	3.8	2.2
Total, 15 and over	815	214	26.3	12.3

from modern experience in support of the important conclusions advanced. The most recent work on the subject, *Diseases of Occupation and Vocational Hygiene* by Kober and Hanson, contains only a few references to the subject, chief emphasis being placed upon glass blowers' cataract, which, it may be said in this connection, is a strictly occupational affliction and should in every case be brought within the scope of workmen's compensation laws. The only really useful data derived from trade-union experience are contained in the report on *Women and Child Wage-Earners in the Glass Industry*, issued as one of the volumes of a larger inquiry made by the Bureau of Labor Statistics, and published as a Senate document in 1911. This experience has been referred to in my own discussion issued by the Bureau of Labor in 1918. It will be sufficient for the present purpose to point out that the proportionate mortality from pulmonary tuberculosis among a total number of 898 deaths from all causes was 31.96 per cent., or, if all deaths from tuberculosis are considered, 32.8 per cent. In addition, the proportionate mortality from non-tuberculous respiratory diseases was 10.8 per cent., so that of the total mortality from all causes, 43.6 per cent. was due to respiratory diseases of the tuberculous and of the non-tuberculous type. It is most regrettable that this interesting experience should not have been made the subject of further study carried on by modern methods of scientific research.

What may be done in this direction is best illustrated by the research work of the committee on dusty trades of the National Tuberculosis Association, for the time being limited to granite workers in Vermont. This investigation is being carried on in co-operation with the state board of health, the state tuberculosis association, the state sanatorium, the state manufacturers' association, the Vermont branch of the International Granite Cutters' Union, the state commissioner of industries, the state commission on dusty trades, local physicians and experts from other parts of the country, including the Trudeau Foundation of Saranac Lake. The investigation has been chiefly concerned with an analysis of the actual mortality experience, including, in the case of the labor union, a period of more than twenty years and covering the entire United States for the purpose of control. An analysis has also been made of the total mortality of Washington County, amplified by personal inquiries of every man employed in granite cutting at the present time, and by special reports upon the place of employment, the home, and the physical condition of the workman as disclosed by a thorough examination, including an x-ray of the chest.

The results of this investigation are so extremely suggestive that it is to be hoped that they may prove a model for subsequent similar inquiries into other trades. For granite workers, at least, the evidence is absolutely conclusive that the mortality from pulmonary tuberculosis has increased approximately three times the rate prevailing twenty years ago, although in the meantime the corresponding mortality of males, aged 20 years and over, in the state of Vermont has been reduced to one-half. The cause of this enormous increase is directly attributable to the increasing use of pneumatic tools producing an extremely fine dust, the ultra-microscopical particles of which are most harmful to the lungs. The dust particles produce a condition of pneumonoconiosis which in course of time results in a superinduced true tuberculosis. The most extraordinary result of these investigations is the disclosure of the fact that it takes approximately twenty-one years before the maximum effect is produced, and that comparatively few deaths from pulmonary tuberculosis occur among men exposed to granite dust during the first ten years of their employment. This inves-

tigation would have been inconclusive but for the generous aid of the International Granite Cutters' Union, which placed its entire records before the committee for independent re-examination and analysis. The results, however, even then would have had little more than academic value if it had not been for the willingness of the labor union to have its entire membership submit to a physical examination, including an x-ray of the chest, to determine the true extent of lung injury as the result of continuous and considerable dust exposure. It is anticipated that probably not less than 1,200 examinations will be made, and it is most gratifying to be able to say that the labor union has unanimously voted to assess itself $1.00 per capita as its share of the expense of this useful investigation.

In view of the excessive mortality from pulmonary tuberculosis and possibly from non-tuberculous respiratory diseases among certain occupations in the glass industry, it would seem of equal importance that a corresponding investigation should be made into the glassworkers' trade. There should be no difficulty in securing a similar whole-hearted co-operation on the part of the state authorities, the manufacturers, and the labor unions, the assistance of all being absolutely indispensable if the best possible results are to be obtained. All of the information secured in such an investigation concerning individual establishments or individual employees is considered strictly confidential, since it is only the collective results that are of most value for teaching or remedial purposes.

The glassworkers' trade is one of the most indispensable and useful occupations known. The prolongation of the glassworker's life and the prevention of needless disease is, therefore, an important duty of the state and of all voluntary health-promoting agencies which can aid an effort first to ascertain the facts, and then to apply the resulting conclusions for the purpose of bringing about a better state of things. It is sincerely to be hoped that such an investigation will be made so that the facts may be known and, if conditions prove to be better than assumed, a further reduction in extra premium charges for life insurance may accrue to the benefit of wage-earners in the glass industry, and material restrictions may be removed in the case of occupations at the present time considered doubtful.

SURGERY AND INCREASED PRODUCTION*

An Indication of the Methods Available to Decrease the Economic Loss Due to Industrial Injuries

A. C. BURNHAM, M.D.
Attending Surgeon, Volunteer Hospital, New York City

THE economic problems of today are, to a large extent, due to decreased production. While other elements enter into the continually increasing cost of living, such as better living conditions, love of luxury, and social unrest, the high prices are largely due to the fact that for a period of two years a large percentage of the world's population was either in the military forces, and consequently non-producing, or else was engaged in making war supplies which have little utility in time of peace.

The conservation of the man-power of the nation is, in part at least, the duty of the physician and it is necessary that members of the profession recognize this fact and make a concerted effort to decrease the actual loss of productivity due to injury and disease. They may accomplish this both by the effective use of professional skill and by timely instruction and advice given to the employers of labor and workers in industry.

Surgeons have previously taken comparatively little consideration of the element of time in the treatment of injury. In general it was thought desirable to effect a cure as soon as possible, but the main consideration was, and still is, a good functional and anatomical result. Recently, however, surgeons employed in industrial organizations have come to realize that the time element is an important factor and when totally disregarded leads, in the sum total, to enormous losses both to employers and to employees, and, of course, in turn to the community.

* Received for publication Jan. 24, 1920.

Accident surgery is practised today not only by the industrial surgeon — that is, the surgeon especially interested in industrial accidents and their relation to a given industry — but also by general surgeons, many of whom have little or no interest in the subject from an industrial standpoint. For this reason the economic side of the problem often receives scant consideration and, while the surgical results may be excellent, they are no better than those which might have been obtained by the industrial surgeon with a considerable saving in both time and money. It is not intended, of course, that a man physically unfit should be returned to work which he is unable to perform. All that is desired is that the time element shall be taken into consideration and measures instituted to adopt that form of treatment which, other elements being equal, will result in the shortest period of disability and the smallest economic loss to the community.

Prevention of Accidents

Much can be accomplished toward the prevention of accidents by proper advice at the time of employment. When an applicant for a position is examined, the physician can, by his advice, indicate both to the employer and to the prospective employee the work for which the applicant is best fitted. Many accidents have been caused by defective vision or by some other form of disability which rendered the man unfit for certain extra-hazardous occupations. Even so simple an affection as flatfoot may be associated with excessive

fatigue, causing a misstep or a false movement which may result in serious injury.

The industrial surgeon should keep careful records not only from a professional standpoint but also from an industrial standpoint, indicating the cause of the injury and the manner of its occurrence so that necessary safety devices may be installed to prevent recurrence. It is neither necessary nor desirable that the surgeon actually have charge of the installation. It is merely required that he indicate the need, leaving the methods employed to others who are better qualified. Under the present compensation laws every injury means a loss to the insurance carrier so that there is a financial incentive on the part of the employer to take every reasonable measure to reduce the occurrence of avoidable accidents.

The Immediate Care of the Injured

Here the element of time is of the utmost importance. Every injury should receive skilled treatment at the earliest practicable opportunity. Many comparatively insignificant injuries, unless adequately treated, become infected, resulting either in a long, drawn out period of convalescence or permanent disability. From a practical standpoint this need is being met in large organizations by the application of a first-aid dressing at once, combined with immediate treatment at the plant dispensary. This plan has been followed by very satisfactory results.

In the smaller industries where the employed are too few in number for the employment of a company surgeon, there is no definite plan which is generally carried out. The injured workman may receive first aid but he seldom sees a physician until several hours after the injury has occurred. Because of the inconvenience and loss of time, most minor injuries are apt to receive unskilled treatment or none at all. The need of skilled treatment in such cases might be met by the location of dressing stations serving certain localities, each of which would have a trained nurse on duty during the ordinary business hours. A physician would be on duty a portion of the day and would be on call for accidents occurring during his absence. Such a plan would be a great improvement upon the present practice of sending such cases to physicians who are often at a considerable distance from the place of injury.

Methods of Treatment

The method of treatment should receive critical consideration not only as to ultimate cure but also in reference to length of the period of disability. First-aid treatment when applied by semi-trained volunteer workers, in the case of abrasions and wounds, should be limited to the use of measures to prevent hemorrhage and the application of a sterile dressing, after preliminary use of tincture of iodine. Tincture of iodine is now fairly generally adopted as a first-aid dressing, especially when the dressing must be applied at a first-aid station some distance from the office of the surgeon.

Every accidental wound should be considered an emergency operation. A few will require no further treatment after the preliminary use of iodine; most will require a few skin sutures in order to hasten healing; serious or extensive wounds call for skilled surgical judgment and often considerable operative ability. Extensive wounds should be carefully explored, all foreign bodies removed, devitalized tissue excised, well swabbed with tincture of iodine and closed without drainage. This statement is made advisedly and in spite of the fact that in war surgery it was considered wise to leave all wounds widely open. The conditions under which indus-

trial wounds occur are almost entirely different from those associated with battle injuries. Only in the exceptional case should the wound be left open. For example, primary suture is not advisable in wounds where dirt from the street has been ground into the wound, where tetanus infection may be expected, and where foreign bodies cannot be thoroughly removed.

The treatment of infections due to neglected wounds should be promptly and carefully carried out. Lymphangitis and beginning cellulitis should be at once admitted to the hospital and receive active treatment. Whether incision, hot boric acid, Dakin's solution, or cold applications are to be used in these cases depends upon the preference of the individual surgeon. Any of the ordinary methods of treatment will in most cases lead to rapid improvement. Neglect will often lead to spreading cellulitis and permanent disability. Dr. Harry E. Mock * gives some interesting statistics which compare ambulatory and hospital treatment of hand infections. In a series of cases the average loss of time for all hand infections treated as ambulatory cases was 11.02 days, while under hospital treatment the average loss was 7.4 days. He states that every hand infection which showed evidences of becoming at all serious or threatened complications was sent at once to the hospital. If this system is adopted it will greatly increase the first cost of medical care but its saving in loss of time and prevention of permanent disability should more than compensate for the increased cost.

The treatment of fractures must be somewhat modified in order to decrease the period of disability. It is not sufficient to splint the fractured bone for from six to eight weeks and then to turn the patient loose to convalesce for six to twelve weeks longer. There is no doubt that massage, active and passive motion, properly applied heat and, in some cases, electrical stimulation will materially decrease the period of disability following simple fractures. In selected cases the use of traction apparatus properly controlled by repeated radiographs will often prevent mal-union or non-union which in turn lead to prolonged disability. In a very small number of fractures early operative repair may be indicated.

In discharging the workman after the functional cure of a fracture the nature of the work to be done should receive consideration. Men who are not required to exercise great muscular effort may often be allowed to return to work after a few weeks, if no particular strain is put upon the fractured bone. In other cases where a man is required to lift heavy weights or do other similar work, it is unwise for him to return to such work until union is firm. I have seen fractures of the humerus recur in men, otherwise apparently normal, more than six months after the original injury. After union is reasonably firm, functional use promotes strength and bone formation. In cases of this type it is often advisable for the injured employee to undertake some form of light work during the period of healing. In many cases it is difficult for the surgeon to persuade an employer to take on a man not entirely fit for work, and it is frequently difficult to make the employee see the necessity of light work in the process of recovery. However, if the surgeon will spend a little time in the education of both employer and employee, he will usually be able to make them both realize that employment, as soon as is compatible with the nature of the injury, will in the end work for the benefit of both the employee and the industry.

Injuries about the joints often lead to prolonged periods of idleness. According to recent reports on war surgery, joint injuries heal more rapidly when subjected to

* Mock: *Industrial Medicine and Surgery*, Philadelphia, W. B. Saunders Company, 1919, p. 585.

active movement from the start. Active mobilization of injured joints was the generally accepted form of treatment during the last year of the war. Favorable reports have followed the use of this plan of treatment in industrial surgery, but it is perhaps too early to state that it will result favorably in cases of all types. However, it is in line with the recognized treatment of sprained ankle, the treatment of which has undergone a radical change during comparatively recent years. Most surgeons can remember when sprained ankle meant disability for a period of from two to six weeks. Now the ankle is strapped and the man ordinarily returns to work within a few days.

Burns, if treated with ointments or wet dressings, are apt to lead to prolonged periods of disability. Recently the application of melted wax has been advocated as much superior to the older methods. If good results are to follow its use, the utmost care is required in its application. The granulating surface must be well dried and the dressing applied daily. In the experience of the writer, the open air treatment of burns, after the first few days, is much better than any other plan of treatment. The granulating areas may be constantly exposed to air or may be exposed only for a few hours during the day, being dressed at night with a boric acid or saline wet dressing. During the late stages the application of skin grafts will materially hasten the growth of epithelium.

Functional Re-education

After certain injuries there is a distinct loss of function, which is partially due to the injury and partially secondary to disuse. The muscles are atrophied, the circulation is poor, the joints and tendons are stiff, and the skin is pale and flabby. Such cases require functional re-education, associated with the application of moist or dry heat and well-controlled passive motion and massage. Excellent results have been obtained in war cripples by the use of these measures. It is to be emphasized that functional re-education is hardly in the province of the individual surgeon. The use of simple machines and apparatus, combined with massage, hot and cold baths, and baking, is best carried out in a clinic devoted exclusively to work of this type. The psychic effect upon the patient of receiving treatment together with other men suffering from similar disabilities is excellent. When treatment is begun, others are seen who are nearly ready for discharge and the patient learns at first hand of the excellent results obtained. He is consequently more ready to devote his time seriously to the necessarily long and tedious course of treatment. Such a clinic has been established in many of the army hospitals, and the Livingston Street Clinic for Functional Re-education in New York City is devoted exclusively to work of this sort, both for disabled soldiers and for industrial injuries. Such a clinic should be established in every industrial center. In a clinic of this sort expert surgical opinion should be available so that the disabled worker may receive full benefit from the best type of surgical treatment.

Vocational Re-education

Thousands of ex-soldiers and sailors are now being trained by the Federal Board for Vocational Education. Men who, as a result of injuries received in service, are permanently handicapped in their old occupations are being trained so that they may be able to overcome the physical handicap. Men who, because of the loss of an arm or leg, would probably have become government pensioners have been trained so that they are now able to command high wages as skilled workmen and are not only supporting themselves but their families as well. Federal legislation for the education of industrial cripples has recently been

enacted and a federal appropriation is available to each state which will make an equal appropriation for the work. Some idea of the extent of the work of the federal board may be gained when it is realized that during 1919 vocational schools received more than a million dollars from the federal government.*

The part the surgeon plays in this phase of rehabilitation is that of an expert advisor. Having in mind the particular disability, he should pass upon the advisability of returning a cripple to his old occupation and the practicability of the proposed course of training.

* Cummings, John: *Vocational Schools Federally Aided,* The Vocational Summary, Dec., 1919, **2**, 143.

Summary

1. The surgeon, in order to do his entire duty by the injured wage-earner, should consider not only the medical aspects of the patient but the economic aspects as well.

2. General production may be increased and economic loss decreased by the scientific application of modern surgical methods.

3. Every surgeon who is required to deal with the casualties of industry should be thoroughly informed upon the subject of vocational re-education and should, by his advice to employer and employee, encourage this humanitarian movement to salvage the industrial cripple.

THE MODERN SPECIALIST IN UNREST: A PLACE FOR THE PSYCHIATRIST IN INDUSTRY *

E. E. SOUTHARD, M.D.
Professor of Neuropathology, Harvard Medical School

INDUSTRIAL medicine exists; industrial psychiatry ought to exist. That industrial medicine exists is attested by the founding of national and local societies, journals, personnel groups, and by the pursuit of researches; industrial psychiatry, while it has logical claims to existence, has hardly taken shape. In a paper on " The Movement for a Mental Hygiene of Industry " appearing in *Mental Hygiene* for January, 1920, I have collected those few references which indicate the probable future course of industrial psychiatry, of industrial psychology and of the new field of psychiatric social work as applied to industry. In that communication on the general aspects of the new movement I tried to state the issues for non-medical readers, especially for those advanced engineers, employment managers, and other industrialists who see more in industry than either its " efficiency " aspect narrowly taken, or its " welfare " aspect narrowly taken. I would be pleased if I could, in the present communication, awaken the interest of psychiatrists themselves to what must be conceived as another immediate addition to the community functions of the psychiatrists. In some sense, then, the present communication is a foil to my earlier paper written for laymen on the movement in general.

I seize the opportunity afforded by the fortieth anniversary of the founding of the Boston Society of Psychiatry and Neurology for the present purpose, because that society is well representative of the two sides of psychiatry that have developed, rather independently, from the necessities of the state-care program for the insane on the one hand, and from the necessities of private psychiatric and neurological (including medico-legal) practice on the other. This society, made up as it is of both kinds of psychiatric practitioner, public and private, ought to be especially sound upon new matters like the development of industrial psychiatry, which touches public, social and individual interests alike. As my hearers are thoroughly aware, between the work of the public psychiatrists — whether busied with hospital administration and treatment or concerned with medico-legal decisions — and the work of private practitioners in neurology or psychiatry — men busied with the individual problems of diseases for the most part falling short of the asylum degree — there has come recently to fairly complete logical development the new field of social psychiatry, a field wherein the problems of the probate court and the problems of the consulting office are amplified, developed and pursued in a hundred ramifications in the social web. Many of our public practitioners of psychiatry, that is, the institution men of the commonwealth of Massachusetts, are already convinced of the value of psychiatric social work in this new intermediary field which lies between the fields of public practice and private practice in mental diseases as these fields have been construed up to recent times. The files of the Psychopathic Hospital will soon contain many thousand socially investigated cases, derived from Boston and the surrounding metropolitan district. But private practitioners in neurology and

* Address at the fortieth anniversary of the Boston Society of Psychiatry and Neurology, Jan. 15, 1920. Received for publication Feb. 28, 1920.

psychiatry are also becoming aware of the values of the psychiatric social worker for any private practitioner who takes his job seriously and seeks to solve his psychiatric problems with all modern aids.

The three fields of public, social, and individual practice in psychiatry are thus well logically in mind in Massachusetts, as indeed they are becoming clear to most other Atlantic seaboard states and to all urbanized communities that have faithfully undertaken the work of mental hygiene on approved lines. Yet some of us, I fear, may still regard this intermediary field of social psychiatry more as a theory than a condition. Luckily, the men who think practice more important than theory are fast dying out or undergoing belated conversion through reflection on the successes of theory in the Great War. If, however, you actually do meet one of these incorrigible practical men who will see nothing in theory, it is as a rule enough to show him the results of social psychiatric practice among the relatives of the victims of neurosyphilis — general paresis and the like — to convince him that mental hygiene has unlocked a brilliant and efficacious novelty for public health in its work upon the so-called "syphilis of the innocent." I make this point about social psychiatric practice somewhat at length, not so much for my present hearers as for others who may read the printed remarks and wonder whether after all there exists a personnel to attack such widely ramifying problems as those of industrial psychiatry. There does exist the appropriate personnel for work in industrial psychiatry. There is, to be sure, not enough such personnel; but there do exist competent workers who can be multiplied as soon as industrialists begin to crave this personnel and as soon as psychiatrists see the peculiar values of the new work.

Why do I speak of the mental hygiene of industry? Why should the medical man enter fields like those of psychology and social work, fields in which he is not competent by special training or by daily experience? We all know that there is a border-line between the work of psychiatrists and the work of psychologists, and that claims and counter-claims have been made by representatives of psychiatry and psychology. Why is it not better for psychiatrists to pursue their own expert ways, leaving psychologists to theirs? We are all aware that heated discussions have taken place in national associations anent, for example, the so-called "diagnosis of feeblemindedness," which seems a medical problem to the psychiatrists and an educational problem to the psychologists. It seems to me, however, that although heated discussions upon abstract lines may occur at society meetings, there is absolutely no practical or concrete difficulty in marking out the peculiar uses of the psychiatrists and the psychologists in particular, concrete cases of mental disease or defect. For example, at the Psychopathic Hospital the work of Professor R. M. Yerkes, psychologist to the hospital, ran with perfect smoothness alongside of the work of the psychiatrists in the hospital wards and the out-patient service. On these practical grounds, as well as on sound theoretical grounds, I conceive that it is both tactical and strategic to place psychiatric art and psychological science under the one head of "mental hygiene," a term which has medical suggestions, but which has also equally pronounced suggestions of normality and health. Where so many of our problems in the social division of psychiatric practice lie along this border-line between normal and abnormal, I conceive that the term mental hygiene is perhaps the best that can be found to describe the sudden enlargement of the psychiatric range in recent years. But, together with the psychiatrist and the psychologist, I would also range a psychia-

tric social worker as a third kind of mental hygienist. The mental hygiene of industry will of course require the services of all three types of mental hygienists, as I endeavored to make plain in my communication for laymen entitled "The Movement for a Mental Hygiene of Industry." As psychiatrists and physicians we shall not forget the importance to mental hygiene in general of mental hospital nurses, of occupation workers, and of specialized types of teachers for mental diseases and defects. But these latter varieties of mental hygienists are not so much in point in the primary field of industrial psychiatry. In that field a working party, composed of psychiatrist, psychologist, and psychiatric social worker should, if possible, have added thereto a person skilled in tabulation and statistics.

I have just employed the phrase *working party* in the mental hygiene of industry. Such a working party would be of value in almost all other fields of mental hygiene — for example, in the survey of a state or district, an occupation group, a racial group, or any other special group of persons whose mental hygiene demanded attention. Parenthetically, I am sure you will all agree that there is hardly any group of persons in the world that would not benefit from mental hygienic analyses made upon the triple lines herein indicated. Thus, such a working party, composed of psychiatrist, psychologist and social worker, can already be found in advanced juvenile courts, and even in certain courts for adult cases, and would undoubtedly be of the utmost service in all domestic relations courts. Again, in schools, in various institutions for the care of children, this combined insight would penetrate many a dark corner.

But industry seems to me to be the problem today nearest to the hands of mental hygiene. One is impressed with the readiness of industry for such working parties in mental hygiene. The war has brought industrial problems into sharp relief; reconstruction has altered the focus in places but has not abolished the problem. Above all, there is at the present day the so-called industrial unrest, a problem met apparently with not too great intelligence, if we can judge by the nullities and silent dispersal of certain national industrial conferences in our country. To be sure, the Royal Commission on Industrial Unrest in England during the war time (1917) did important service in laying down certain concrete findings and recommendations, but those results were war-time results confined to Great Britain. The psychiatrist who reads the Royal Commission reports can scarcely avoid being convinced that greater and more significant results could have been obtained if the principle of the mental hygiene working party could have been adopted in the British investigation.

A word or two is in place about the respective functions of the members of a mental hygiene working party. For the benefit of those who come to this problem for the first time, let me insist that such a working party is not proposed for the purpose of supplanting the employment or personnel manager or any other major or minor executive in the industrial plant. I hope to convey by the term working party the idea of an investigation, occasional rather than permanent, carried out by special officers having the weight of certain connections outside of the industrial plants themselves. Of course the psychological examiner will no doubt prove a relatively permanent portion of the organization of an industrial plant as soon as plant managers get clearly in mind the successes of psychology in the army in the classification of personnel and in the elimination of the unfit through group and individual mental tests. Probably this aspect of the propaganda for mental hygiene may be regarded as properly under way though, in my opinion, certain plants

have at least been adopting it more as an efficiency device than as a welfare or social adaptive measure. But the tendency to exploit the values of mental measurement for the mere elimination of the individual from a particular plant will be short-lived if we can somehow kindle the spirit of mental hygiene in the whole industrial problem. After all, the psychological examiner will find himself of greatest value in the employment or hiring side of the plant's work. As the years pass, the psychologist may also learn to contribute to the problem of promotion upon lines of vocational psychology. But for the present the psychological examiner, in the narrow sense of this term, will be of decidedly lesser value in the interpretation of the discharge-rate or turnover in industrial plants. The industrial plant should have the list of discharged employees gone over from time to time by a consultant psychiatrist or a neurologist interested in the psychiatric side of this work. Such consultant psychiatrist should be in complete touch with the psychological examiner and should have at his disposal such records of mental testings or other recorded impressions as the psychologist may have. He should likewise be able to secure and interpret the records of social work, especially those made in connection with discharged employees.

The psychiatric social worker, like the psychological examiner, will probably become a permanent element in the plant, although most of her work may well be done outside its walls in the community and especially in the families, even of those who become industrially disabled and of those who are discharged, when the reasons for their discharge are consistent with the spending of the plant's time and money on their families. Luckily, in advanced urban communities the standard of social welfare has been advanced at least to the point reached by the standards of efficiency inside the plants. The result is that by a minimum of exertion on the part of the social worker, proper transfers of these families of discharged workmen to other agencies can be arranged for. Where there are a number of industrial plants in a single community, the social workers connected with these plants would naturally be closely associated with one another in their social conferences and society meetings. Industrialists tell us that co-operation is more the order of the industrial day than competition. However this may be in industry as a whole, there can be no doubt that the social treatment of families of employees discharged from plant A will benefit the turnover sheet of plants B and C, etc. If plants B and C employ social workers of like skill, plant A will in turn benefit in its turnover sheet. In brief, the welfare of the discharged to a certain extent means the efficiency of the plant. The general problem of turnover is aided by the well-known principle of mutual "back-scratching." Meantime, the welfare values obtained for the community as a whole run beyond the superficial relief of the industrial skin.

How soon it will be possible to make physicians in general and medical social workers, not especially trained or expert in mental problems, see eye to eye with the psychiatrist and the psychiatric social worker in this matter of the mental hygiene of industry, is hard to say. However, from the operations of national and local societies of industrial medicine, it appears that physicians in general are becoming much alive to the virtue of this new combination of medicine and engineering. Psychiatry has made such strides in relation to the more superficial problems of social work that psychiatrists are often overwhelmed with the kind and degree of expectation uttered by social workers. The extreme range of such expectation is shown in the files of the out-patient department in the social service of the Psychopathic Hospital in Boston. Much is expected of the psy-

chiatrist in the new social division of his practice.

It is particularly in the grievances that come to the attention of the employment manager that the psychiatrist will find his work laid out. In the communication on the " Movement for a Mental Hygiene of Industry " above mentioned, I have quoted from Read a list of causes for removal from a certain large payroll. The following entries will readily suggest to the psychiatrist what sort of investigation ought to be carried out, especially with the aid of the psychiatric social worker:

Certain Causes of Removal from Payroll

Did not like supervision.
Refused to be transferred.
Resented criticisms.
Did not like working conditions.
Work too hard.
Agitator.
Carelessness.
Dishonesty.
Drinking.
Fighting.
Indifference.
Insubordination.
Too slow.

There is also a paragraph called " superintendent's private file " among the " unsatisfactory " groups of removals that might well be looked into by the consulting psychiatrist. Where do all these grudge-bearers, agitators, drinkers, fighters, and lazy persons go? Some of them figure within a comparatively short time in the discharge files and turnover analyses of nearby plants. We may talk of the solution of such problems as a duty of the community, but it should not be long before industrial plants themselves recognize the efficiency and welfare virtues of attending as strictly to their human outgo as to their human intake. I mentioned the work of the British Royal Commission on Industrial Unrest in 1917. I present a summary of their findings made by the Right Honorable G. N. Barnes, M.P., not because all of the fourteen items are particularly related to our own or to any special problem in industrial hygiene but to show the general nature of the Royal Commission's work.

Summary of the Industrial Unrest Findings in England, 1917, by G. N. Barnes, M.P.

1. High food prices in relation to wages, and unequal distribution of food.

2. Restriction of personal freedom and, in particular, the effects of the munitions of war acts. Workmen have been tied up to particular factories and have been unable to obtain wages in relation to their skill. In many cases the skilled man's wage is less than the wage of the unskilled. Too much centralization in London is reported.

3. Lack of confidence in the government. This is due to the surrender of trade-union customs and the feeling that promises, as regards their restoration, will not be kept. It has been emphasized by the omission to record changes of working conditions under schedule LL, article 7, of the munitions of war act.

4. Delay in the settlement of disputes. In some instances ten weeks have elapsed without a settlement, and after a strike has taken place the matter has been put right within a few days.

5. Operation of the military service acts.

6. Lack of housing in certain areas.

7. Restrictions on liquor — this is marked in some areas.

8. Industrial fatigue.

9. Lack of proper organization among the unions.

10. Lack of commercial sense — this is noticeable in South Wales, where there has been a breakaway from faith in Parliamentary representation.

11. Inconsiderate treatment of women, whose wages are sometimes as low as £13.

12. Delay in granting promises to soldiers, especially those in class " W " reserve.

13. Raising of the limit of income tax exemption.

14. The workmen's compensation act: the maximum of £1 weekly is now inadequate.

Among the recommendations of the British commissioners are to be found recommendations concerning:

1. Food prices (of which the commission stated there should be an immediate reduction with an increase price partly borne by the government and with a better system of distribution).

2. Industrial counsels on the principles of the Whitley report.

3. Authoritative statements by the government as to further increase of output (wartime conditions).

4. Participation by labor in the affairs of the community as partners rather than as servants.

5. Publicity in certain matters relative to leaving employment.

6. Publicity by the government concerning its pledges already given.

7. Raising of the £1 maximum under the workmen's compensation act.

8. Announcement of the policy as regards housing.

9. Skilled supervisors to receive bonus.

10. Closer contact to exist between employer and employee.

11. Pensions committee to be granted more discretion. Treatment of men discharged from the army.

12. Certain agriculturists' wages to be raised.

13. Colored labor not to be employed in ports.

14. A higher taxation of wealth (by one commissioner).

According to the commission's report, there were the following four universal causes for unrest in England: (1) food prices and distribution of supplies; (2) restriction of personal freedom; (3) card system for military and industrial service; (4) incoordination of government papers. Certain acute though not universal causes of unrest were: housing, drinking, and fatigue. The commission also speaks of "psychological" conditions and remarks that "the great majority of the causes of industrial unrest specified in the (8 district) reports have their root in certain psychological conditions." Among these may be mentioned: lack of confidence in the government, feeling of inequality of sacrifice in army and industry, the idea that solemn pledges were broken and turned into "scraps of paper," feeling of unreliability of certain trade-union officials, and feeling of the uncertainty of the whole industrial future.

The commission was no doubt justified in laying enormous emphasis on what it calls "psychological" conditions. The psychiatrists and the medical men in general must feel that the blanket term psychological condition covers a good many psychiatric difficulties. Thus, whoever follows the strong trend to individualization in medicine, psychiatry, in education — both intellectual and moral — and even into the law courts, must be convinced that individualization should proceed to greater lengths in industry. There is nothing more wide-spread in modern sociology than certain ideas about group action as the "be all" and "end all" of progress and failure in social developments. As one author puts it, group experience leads to group thought, group thought to group action. If we take, for example, the universal causes of unrest summarized by Barnes of England, we shall of course be convinced that food prices might well be a group experience, a poor distribution of supplies might be to a large extent a group experience. There would also be a group experience of the evils of card systems which might lead to group thought, and unrest of mind might create tendencies to strikes; distribution of supplies would tend to follow group experience and thought as in the case of prices and service cards. When it comes, however, to a question of the restriction of personal freedom and to a question of government inco-ordination, it must be observed that these are hardly group experiences as much as individual experiences. The workman who objects to being passed automatically from one sphere of labor to another may make himself heard effectively in group thought; the victim of some inco-ordination on the part of government departments may do the same. But it certainly must be true that the effects of such restriction of freedom and of temperamental inco-ordination are, as a rule, individual. The voices of the victims, however, are raised along with the voices of general unrest concerning food prices and the service card system.

We cannot help thinking that the principles of social work and especially psychiatric social work, applied to the problems of

the restriction of personal freedom or of temperamental inco-ordination, will solve most of the problems. The matter of automatic transfer from certain spheres of labor is of course a war rather than a peace matter, but the item will serve as well as another to indicate that universal causes of unrest need not be the product of group experience, need not have led to group thought, and need not lead to group action unless in the presence of other more general causes of unrest. Many of these problems, possibly the majority of them, are extraordinary rather than main problems. The same holds for the "acute" as contrasted with the "universal" causes of unrest, most of which acute causes are described by the commissioners as arising locally from different problems, such as family housing, drinking, fatigue, or even such a problem as that of lack of confidence in the government, specified among the findings as lack of commercial sense (No. 10). We find from the commission's report that this lack of commercial sense was especially noticeable in South Wales where there had been a break-away in faith in parliamentary representation. I do not know any single important fact relative to South Wales and its break-away from the democratic faith, but certainly there must have been a local condition which no doubt had local causes, some of which are almost certain to have been due to the operations of a particular man or group of men.

This introduces us to the most general aspect of the unrest problem, the aspect which leads me to give to my paper the somewhat cryptic title of "The Modern Specialist in Unrest." It may be — or, as I suspect, it may not be — that group experience leads to group thought and group thought to group action as the ordinary course of events in social developments. But whether these developments are group matters or not, it remains true that most of the information which we possess concerning group psychology and group psychopathy is derived from the psychology or the psychopathy of the individual. If this statement be accounted true, then I do not need to insist that the psychiatrist is rather more likely than any other expert to know how the main lines of unrest will run. Unrest on the part of the individual is the big problem of the psychiatrist; year in and year out he comes in contact with the finest, as it were, and the most brilliant examples of unrest in the shape of particular patients in his wards. If this general account of things be correct, the psychiatrist ought to have a message for industry. Psychiatric knowledge about the unrest of the individual ought to be turned to account in our analyses of group unrest.

The main thesis of the present communication is that a psychiatrist has a place in industry. I think that he will have a place in the routine of industrial management, not as a permanent staff member (save in the instances of very large firms and business systems) but as a consultant, at stated periods, relative to the matter of grievances, complaints and dissatisfactions, actual and potential. The function of this occasional consultant would be preventive rather than curative of the general conditions of unrest. How far we can think of the industrial psychiatrist not merely as a preventive agency, but as a curative agency for conditions of unrest, the future must decide.

What is unrest? The theory that group experience leads to group thought, which in turn leads to group action, may be sound theory for a portion of industrial phenomena, but individual experience, individual thought, and even individual actiou are also factors in industrial situations. How far is unrest a matter of group or crowd or mass psychology? How far does mass psychology depend upon the psychology of the individual member? It will not be wise to generalize to the effect

either that industrial unrest is entirely a group phenomenon or that it takes its rise entirely in the minds or in the hearts of individuals. We have seen that some of the causes of unrest in England might well be matters of group psychology, but that other causes of unrest seem almost in their nature to have been of individual origin.

That portion of the unrest problem which depends not upon group experience but upon individual experience, not upon group thought but upon individual thought, and finally not upon group action but upon individual action, is the proper topic for the psychiatrist. The psychiatrist, particularly in company with the psychiatric social worker, has always been a specialist in unrest — unrest, to be sure, confined within asylum walls. The modern psychiatrist has under more or less definite supervision large numbers of the so-called psychopathic personalities — persons who are not insane in a kind or degree to warrant their commitment to institutions, but who are psychopathic enough or in such wise as to benefit from community supervision. It is this modern contact with the psychopathic personalities, with instances of so-called psychopathic inferiority, with psychopathic states, that makes the modern psychiatrist a specialist in a kind of unrest that interests the community very deeply. These psychopathic personalities have been recognized even in the immigration laws and in the official tabulations of the Army and Navy under the terms "constitutional psychopathic inferiority," "constitutional psychopathic state," and similar designations.

It is important for the modern psychiatrist not to "hide his light under a bushel"; he must step forth to new community duties. It is on this account that I conceive that a recent step of the Engineering Foundation, representing the United Engineering Society, is of so much importance. Among the earliest problems undertaken by the Engineering Foundation is the problem of the mental hygiene of industry. To the writer, as the Director of the Massachusetts State Psychiatric Institute, was entrusted a research of definite dimensions, relative to the mental hygiene of industry and the problem of mental abnormalities in relation to industrial personnel. The enlightened officers of the Engineering Foundation immediately found the ramifications in the research of mental hygiene of industry so numerous and so broad that a plan is being mooted for investigation of the entire problem of industrial personnel. On the suggestion of the Engineering Foundation, the National Research Council appointed a committee, composed of representatives of its divisions of anthropology and psychology, educational relations, engineering, industrial relations and medicine, to consider the scope of investigation into industrial personnel.

It seems to me that as psychiatrists we should help this movement wherever it becomes practically possible. The practical possibilities of helping lie in connection with the fact that the majority of our male patients have either come out of industry or are going back into industry in some capacity. Special investigations of the individual patients with respect to their industrial status and future should be made. The information which the psychiatrist possesses concerning personality, temperament, and special abilities, as modified by mild mental disease and defects, should be at the call of the employment manager. There should be a drawing together of the psychiatric and industrial interests of all communities. The psychiatric social workers of the state institutions should meet similar workers from the industrial plants to discuss the individual fates of particular discharged workmen. Psychopathic persons can be fitted into industry far more successfully than most psychiatrists and

industrialists are feign to believe. The employment work at the Psychopathic Hospital during the last four years has definitely shown these adaptations of the psychopathic employees to be both numerous and effective.

I do not need to rehearse to this audience the early conclusions of Dr. Adler concerning unemployable personalities, based upon Psychopathic Hospital studies, more than to recall the immediate sub-divisions which he made into the problems of fitting into industry (a) the feebleminded, (b) the cyclothymics, and (c) the paranoiacs. Every employment manager is aware of the existence of the feebleminded and of their availability for certain kinds of work. Industrialists are also quick to recognize the cyclothymic with their ups and downs of emotional mood as actual inhabitants of mills and mines, and much can quickly be taught the employment manager concerning the special virtues and faults of these victims of the cyclothymic constitution, and even of the more severe forms of manic-depressive psychosis. The paranoiac patient is ready to be recognized by the employment manager as a man with a grudge or chip on his shoulder. In fact, the task of letting in a little psychiatric light upon these problems is not so difficult as might be conceived; the success of Psychopathic Hospital clinics for employment managers in the summer of 1919 attests the value of spreading these practical doctrines of mental hygiene among industrialists.

SOCIAL WORK AND INDUSTRIAL HYGIENE

A. WARREN STEARNS, M.D.
Medical Director, Massachusetts Society for Mental Hygiene

In more primitive times the king's barber was also his doctor. But the demands for the two kinds of attention soon increased to the point where one man could not master both arts. So, certain men devoted their whole lives to healing and all that goes with it. Then the kindly friend who was called doctor did all that is done today by doctors, druggists, dentists, nurses, and social workers. But in accepting these colleagues, the modern doctor has relinquished, at times reluctantly, certain of his prerogatives. "He makes his own instruments," is no longer spoken in praise of a surgeon. And the doctor who does his own social work is usually he "who rails at progress with a narrow mind, and marvels much that he falls behind."

Fortunately social work is now universally accepted as a necessary adjunct to medicine, and medicine has become indispensable to industry. How far has social work followed medicine in this field? Not far, I fear. But, if social work is indispensable to medicine, is it not essential in industrial medicine? It is; in no field of medical practice is the social worker more needed than in industry. This man has an injury and is to be cared for at home. What is the character of that home and what are the chances of his life there being conducive to recovery? The visit of the social worker not only answers this question but carries the advice necessary for making home care possible. The next man shows a falling off in his work, he is irritable and difficult to deal with. His health seems good so far as physical examination can reveal but the social worker finds harassing conditions at home which readily explain his irritability — difficulties which she can perhaps remedy. A patient cannot be treated with disregard of his family; in fact, the family itself must be treated.

The social worker thus becomes an aid in the problem of industrial relations. In fact, to try to outline the place of social service in industry would be but to review its place in medicine. But in industry there is still another aspect of social work which offers opportunity. The social worker not only has an important relation between doctor, patient, and home, but an equally needed place between doctor, patient, and employer. I have frequently seen an injured employee advised to return to work but to confine his efforts to some "light job." Who arranges this matter? Usually no one, for such patients are often turned over to a foreman with inadequate care or consideration. He either does nothing or too much, and so fails. The doctor cannot do his work well and attend to either home or factory adjustments. Expecting untrained families or foremen to make these adjustments means failure.

Lastly the field of research must be considered. No man of worth in any walk of life is content to labor on routine without opportunity to conduct investigations as problems arise, and medical research investigators in industry can utilize the social worker to great advantage.

I cannot close this brief statement without some reference to the psychiatric social worker. Already a literature is being created on the mental hygiene of industry. Every company has a certain percentage of employees who are nervously or mentally handicapped. They are especially in need

of social service supervision. Again those important factors in life which come within the range of personality need attention, and here the social worker must be ambivalent, serving both doctor and employment manager. The demand for psychiatric social workers who have received special preparation, such as the Smith College Training School for Social Work and the New York School of Social Work offer, is very much greater at the present time than the supply, but occasionally one with special interest in industrial problems may be secured for work in a plant.

THE SUCCESSFUL INDUSTRIAL MEDICAL DEPARTMENT*

Essential Co-operation of Executives and Employees Gained by Proper Methods

M. BURNETT FRANKLIN, M.D.

Medical Officer, E. F. Houghton & Co., Philadelphia

THE establishment of a medical department in an industrial or other employing organization is usually considered with caution and, not infrequently, with trepidation. The details of location, physical equipment, and general organization offer no problems that cannot be handled readily as are similar details in ordinary business or plant developments. But, unlike most other departmental projects, the establishment of the medical department is concerned largely — in rather intimate and personal relation — with the human element in the group, and more especially in the individual. This factor is doubtless one of the most vital ones in the success or failure of the new organization.

The establishment of a medical department, therefore, calls for the utmost tact, judgment, and discretion. From the very first open frankness must prevail and this keynote, properly struck, can and must be maintained to " sell " the medical department to those concerned — executives and employees alike. It must be recognized that this new venture, especially where it is altogether new, must be "sold"; it must be accepted freely and fully for a precious price. That price — complete co-operation and friendliness — must and will be paid freely under proper methods and due tactfulness. This factor is emphasized so strongly here because the experience and observation of the writer, as well as of others, prove its importance. Experience on this point in the establishment of a medical department in a large Philadelphia industrial plant affords a concrete practical example.

* Received for publication Dec. 20, 1919.

The " family spirit " among the employees of the plant in question is rather highly developed. This is especially true of the nearly 200 women employees in the general offices. Certain of the women department heads have had long service in the company, and have traditionally been leaders among the women and girls. The same condition applies in a smaller measure to the men employed, many of whom have been with the firm a long time. The value of the immediate co-operation of all such employees is apparent, but to favor any group by a special or prior approach would immediately cause resentment. The problem with the women and girl employees is especially delicate in this particular. In establishing the medical department every feature as to possible effect on the attitude of the women employees, as to the effect on labor, and on labor organizations represented among the men, as to the effect of rulings by the medical officer on new and old employees, detailed method of organization of the force to aid the medical officer, first-aid instruction, physical equipment, necessary forms and procedure in examination, and other details were considered.

Fully equipped offices for the department were provided from the start. This is important not only from a practical working standpoint, but also from the effect of thoroughness produced at first contact. In selecting a location for the offices of the

medical department, advantage was taken of the fact that high-grade lavatories, shower baths and locker rooms had been previously installed both for men and for women. The medical department was placed adjacent to them, thus making it unnecessary to provide special facilities.

A brief reference to the equipment provided is of interest. Incidentally, as a matter of tact, the equipment in the various shops, etc., was not installed until after the entire project had been explained to the employees. The waiting room, examining room, and emergency operating room are all fully equipped with standard fittings and apparatus. The rooms are well lighted and ventilated, and present a cheerful aspect. This element is a worth-while consideration both from the standpoint of practical usefulness and because of the general good mental effect. First-aid cabinets are distributed throughout the plant. Stretcher-cots are strapped to the walls at convenient points. This equipment is in charge of a foreman or other person in each department who is responsible for its current upkeep and efficiency. These persons are the only ones authorized to apply the emergency first aid, or to use the equipment and supplies ordinarily. They are specially qualified by reason of regular instruction under the direction of the medical officer — a point which will be considered in further detail later.

The opening of the medical department was considered of such importance that the president and general manager made this his personal business. The employees were gathered informally in the general offices and the president explained in a simple, friendly manner, the new organization. He emphasized particularly the fundamental aims and purposes, classing the work of the medical department as a purely business arrangement, of mutual benefit to the employees and to the company, and in no sense a charitable or paternalistic venture. He outlined the absolute need for thorough co-operation and discussed briefly also the few rules and regulations pertaining to the new department. No person at present employed with the company, for example, need take the medical examination; all new employees must do so, as must employees desiring promotion.

The medical officer was then introduced, and after a few words of greeting, he outlined the organization, and then proceeded to become personally acquainted with his newly acquired patients. This suggests also that the personality and professional standing of the industrial plant physician is of vital importance. In this instance, as the president told his employees, and with marked effect, their new medical adviser was his personal physician, and had been for twenty years.

As has been stated, co-operation is essential to the success of this medical work. When initial confidence had been established, and the danger of antagonism obviated, the next step was the shaping of a working organization. In each department or shop, foremen, forewomen, and others in executive charge were appointed as assistants to the medical officer. The first-aid equipment and supplies were placed in their charge. Two persons in each department were given a series of lessons in first-aid treatment. Actual demonstrations were made in the various shops and offices. This feature is especially valuable, in that the morale is unaffected when real accidents happen. Numerous kinds of accidents have been encountered in the year that the department has been in operation, and in each instance there has been perfect co-operation and conduct. This is in striking contrast to former conditions, as is admitted by the company's executives, when even a minor accident always caused widespread commotion, disorganization, and loss of much time.

This spirit of co-operation has developed

as the medical department by conscientious service has established itself more firmly. Many of the executives of the company consult the medical department on matters of personal health. Timely precautions frequently save the loss of days of an executive's time, with a corresponding uniform efficiency in the department under his or her charge. Similarly, prompt attention to the illness of employees wards off more serious illness and consequent loss of time.

The medical department is called upon for various kinds of service other than in purely professional matters. For example, ventilation standards have been specified to suit the peculiar requirements of the various shops and offices. Fans have been recommended and installed where needed, ventilators prescribed to overcome objectionable drafts, thermometers installed to insure more even temperature, and lighting facilities improved. In fact, a live medical department is always on the alert for any improvement that will benefit the employee, making him a healthier, happier, and more satisfied worker. In achieving this end, the cost of the department is justified, not only as a commendable social endeavor, but as a mutually profitable business relation.

In conclusion, the successful medical department in the industrial plant must have adequate, modern facilities; it must be organized thoroughly to meet every emergency with calmness and efficiency; it must stand on its merits like every other department of a going business; but more than all these, it must have human personality and the spirit that inspires confidence in the human element with which it deals. Having these, the medical department gains and holds the co-operation that means success.

INDUSTRIAL DISEASES UNDER THE WORKMEN'S COMPENSATION ACT *

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

IN the last lecture I dealt with the results obtained from notification of certain industrial diseases. Today, I deal with the results of scheduling them and others under Section 8 of the Workmen's Compensation Act of 1906. In the other lecture I laid stress on the fact that samples of the six diseases which medical practitioners are called upon to report are sufficient for statutory notification and as a clue to conditions over which the Factory Department desires to exercise control. The objects of the Workmen's Compensation Act and of the Factory Act, however, are not the same. The Compensation Act is much wider as it is intended to cover all cases of sickness of strictly occupational origin. The individual is here concerned, and not merely the conditions under which he works. Any description of disease, therefore, for which compensation can be claimed must be worded very widely, so as to sweep into the net all cases and not merely those with marked symptoms. Hence it is that in the description of the diseases scheduled for compensation the broadest designation possible is given, including the sequelae, and a wide description is given of the process in which it is presumed that the worker was engaged, who has contracted the malady.

The principle of the Workmen's Compensation Act was first extended to industrial diseases in the act of 1906 and there are now twenty-seven diseases to which it applies. A glance at the table of the diseases, either as it existed originally in the third schedule or after the addition of certain diseases by Order of the Secretary of State, reveals the absence of certain forms of poisoning and well-recognized trade diseases which might have been expected to find a place. Thus, poisoning by sulphuretted hydrogen gas, carbonic oxide gas, brassfounders' ague and fibroid phthisis, to mention four only, are not named.

Tests Applied to Each Disease

For the reasons which dictated the omission of certain diseases we must look to the tests applied to each disease by the committee on compensation for industrial diseases before the disease in question was held to come within the scope of the provisions and intentions of the act. They were:

1. Is it outside the category of accidents and diseases already covered by the act ?
2. Does it incapacitate for more than a week ?
3. Is it so specific to the employment that causation by the employment can be established in individual cases ?

Now, poisoning by sulphuretted hydrogen gas is invariably sudden, and therefore in the nature of an accident, and aftereffects can be referred back to the definite time when inhalation occurred. Hence, such sudden poisoning is already covered by the act and only poisoning which is slow and insidious in onset and which might not easily be referred back is not covered. Poisoning of this slow type may result from nitrous fumes, carbon bisulphide, or from chronic benzol poisoning. Poisoning by carbonic oxide does not find a place because no convincing evidence was presented to the committee that it should

* Cutter Lecture in Preventive Medicine and Hygiene delivered at the Harvard Medical School, Boston, Mass., Dec. 9, 1919. Received for publication Dec. 11, 1919.

be treated otherwise than as an accident. There would have been danger in scheduling the sequelae of carbonic oxide poisoning, such as loss of memory and dementia, seeing how widespread is the use of gas in industry, and how easily subjective symptoms from it might be alleged with a view to a claim for compensation.

In the very rare instances in which hernia can be ascribed to a sudden strain, it would come within the definition of an accident. The committee, on the evidence heard, could not regard hernia as an industrial disease nor as an injury, not being an accident due to employment.

The second test excludes a malady of the nature of brassfounders' ague, as the attack is transitory and does not last for the period of a week.

The third test would exclude bronchitis and phthisis, but not fibroid phthisis, which the committee regarded as a specific and sufficiently distinguishable trade disease. I will explain how compensation has recently been extended to it. Fibroid phthisis was originally excluded because in no other of the diseases considered is there so long a preliminary period during which there are equivocal symptoms — cough and the like — which may, or may not, become graver and ultimately declare themselves as the disease for which compensation is payable. Every case of cough in a stone-mason, for example, might arouse suspicion that it was a symptom of the incurable disease, involving payment of a large sum in compensation, and unemployment among persons so suffering would, it was feared, inevitably result.

With the exception, therefore, of fibroid phthisis, the intention of the government was to schedule every strictly industrial disease which complied with the principles of selection and had been brought to their notice. This explains inclusion of some extremely rare diseases, such as nickel carbonyl poisoning for which, indeed, compensation has never been paid, the exclusion of the diseases named above and of the group of ordinary infectious illnesses — measles, scarlet fever and the like — when contracted by the worker through chance exposure to infection.

From time to time other diseases have been brought to the notice of the government with a view to scheduling them. Glassworkers' cataract, for example, has been scheduled under the condition that compensation should be made payable for not more than six months in all, and for not more than four months unless the sufferer has undergone an operation for cataract; and writers' cramp with the condition that compensation should not be granted for more than twelve months. Duypuytren's contraction of the hand was not considered by the committee to be proved to be due to industrial employment.

In the first year, 1,897 certificates of disablement were granted. Their number has increased year by year since, and the number in 1914 — the last year for which the statistics are published — was 5,642. Of these, miners' diseases (nystagmus, beat knee, beat hand, beat elbow and sprained wrist) account for not less than 4,957; lead poisoning for 469; eczema and chrome eczema for 88, leaving only 128 to be distributed among the remaining 19 diseases. Returns were collected from seven great groups of industries, i. e., mines, quarries, railways, factories, constructional works and shipping in which the aggregate number of persons employed was more than seven and a half millions. The total amount of compensation paid in 1913 was nearly £3,500,000, of which over £130,000 was for occupational disease. Over 90 per cent. of these claims were by miners; 6.9 per cent. were cases of lead poisoning. The annual charge for compensation per person employed was lowest in factories, being only 5/- per person; in the case of railways it was 8/5; in quarries 10/3; 13/3 in con-

structional work; and in mines 24/3. The total charge, including cost of management, legal and medical expenses, cannot have been less than £5,000,000.

Consider for a moment the amount of invalidity represented by the figures for lead poisoning alone. Plumbism is a chronic malady involving disability in the acute cases for four weeks — seldom less — and in the severe chronic cases for months. Taking an average absence from work of two months per case, the figures for 1914 alone represent ninety years of lost time, to say nothing of the disorganization of home life brought about by the illness. In 1914, in the seven groups of industries compensation was paid in forty-three fatal cases to the amount of £7,099 and in 9,622 disablement cases to the amount of £182,551. The number of "continued cases" was 3,598, or 37 per cent. of the total number (in the case of accidents the proportion was only 8.8 per cent.) and they accounted for £105,742, or nearly 7½ per cent. of the disablement compensation.

From time to time, as experience has shown it advisable, the description of the scheduled diseases has been slightly altered. In general, this has always been in the direction of widening the scope so as to enable the workman to obtain compensation more easily. The first committee which drew up the list of scheduled diseases was inclined, not wishing to take a leap in the dark, to make compensation not too easy. Thus eczema was scheduled as "eczematous ulceration," intending by that to mean that trivial dermatitis was not to be considered. Later experience showed that dermatitis was hardly distinguishable from eczematous ulceration or at any rate was as much deserving of compensation as the graver condition, and now the description of the diseases has been altered to "(*a*) dermatitis and (*b*) ulceration of the skin produced by dust and liquids." Similarly poisoning by nitro- and amido-derivatives of benzene was not wide enough to include T.N.T. and it was necessary to alter the schedule to read "nitro- and amido-derivatives of benzene and its homologues."

TABLE 1. — CASES OF INDUSTRIAL DISEASE IN ENGLAND FOR WHICH COMPENSATION WAS PAID DURING THE YEARS, 1908–14, INCLUSIVE *

Disease		1908	1909	1910	1911	1912	1913	1914
Anthrax	A	4	2	6	2	4	1	4
	B	23	22	35	30	43	44	36
Lead	A	61	146	152	148	192	198	200
	B	421	351	367	406	414	371	344
Mercury	A	..	..	2	1	3	4	3
	B	3	1	2	5	6	17	6
Arsenic	A	..	2	..	..	1	..	..
	B	15	4	10	1	10	6	..
Aukylostomiasis	A	..	..	..	..	..	..	..
	B	6	8	7	6	4	2	4
Benzene Derivatives	A	..	1	5	..	2	4	1
	B	10	8	28	45	30	13	19
Nitrous Fumes	A	..	..	..	..	1	..	..
	B	..	..	1	6	4	8	3
Chrome Ulceration	A	1	..	10	2	4	4	3
	B	20	23	20	22	48	45	28
Eczematous Ulceration	A	1	5	4	6	9	5	4
	B	19	42	30	46	32	38	46
Cancer	A	2	..	..	3	2	3	3
	B	6	9	6	6	12	15	19
Nystagmus	A	74	380	662	1144	1819	2149	3218
	B	386	631	956	1375	1376	2402	2775
Beat Hand	A	28	20	32	38	46	42	60
	B	464	573	774	733	1078	844	817
Beat Knee	A	29	29	33	56	67	64	88
	B	539	881	1136	1402	1259	1630	1609
Beat Elbow	A	8	6	2	6	10	2	7
	B	67	63	80	130	114	136	165
Synovitis	A	..	5	10	4	5	10	10
	B	87	128	95	138	169	197	181

* Column A contains the cases carried over from the previous year; Column B, the new cases. Only those scheduled diseases are included in this table in which an appreciable number of cases occurred. For the full list of diseases see the Secretary of State's Statutory Rules and Orders, 1918, No. 287.

Procedure in Cases of Disease

Procedure under Section 8 of the act, when a disease due to the nature of the em-

ployment is in question, is very different from that in the case of an ordinary accident. As you know in the case of an accident, the claim is made directly on the employer and about 99 per cent. of such cases are settled without reference to the court. If there is any dispute, the case goes straight to court except when an application is made by *both* parties; then, the case is referred to a medical referee — a rare eventuality.

Except in the case of death, which must be proved to have been " caused by " the disease, the starting point of a claim for compensation under the industrial diseases section is a certificate obtained on application by the workman from the certifying factory surgeon of the district in which he is employed. The reason why a certificate is required is because the question whether or not the affected person is suffering from a particular disease is purely a medical one. The certifying factory surgeon was selected, no doubt, because, called on as he is to report to the Home Office on certain forms of scheduled industrial diseases and poisoning, he may be expected to have acquired a certain amount of expert knowledge. His name appears on the abstract of the Factory Act posted up in every factory and workshop. The surgeon certifies to the disablement of the workman, or, if not satisfied, certifies that he refuses thus to certify.

Illustrative Case. — The varying procedure permitted by the act, according to the attendant circumstances of the case, will be most usefully illustrated, perhaps, by taking a concrete instance. A house plumber, let us say, presents himself to the certifying surgeon, pays his fee of 5/-, is examined, and found to be disabled by lead poisoning from earning full wages. The certificate issued will state this, and there the duty of the certifying surgeon ends. It does not fall to him to say how long he thinks disablement will last. When this certificate, or a copy of it, is presented to the employer who last employed the disabled workman within the preceding twelve months, compensation (if the disease is attributable to the nature of any employment in which the workman was engaged within the last twelve months) falls due from the date entered on the certificate as the date of the commencement of the disablement, unless it can be proved that at the time of entering the employment the workman wilfully and falsely represented himself in writing as not having previously suffered. Provision in the section is also made for issue of a supplementary certificate in a case in which, as might conceivably be possible, the certifying surgeon was satisfied that the undoubted lead poisoning from which the plumber was suffering was contracted, in his opinion, from other sources as, for example, drinking water. And again, where the attack of plumbism developed within a few weeks or months of employment under a new master, seeing that like conditions of exposure existed in employment under other masters during the preceding twelve months, the other employers also can be made to contribute their share of the amount of compensation recoverable from the last employer.

Appeal to Medical Referee

Suppose, however, that the certifying surgeon is unable to satisfy himself that the plumber is suffering from lead poisoning so as to be disabled from earning full wages and gives the certificate to this effect, and that the workman, having been treated for this malady and having other medical evidence that he is so suffering, desires to carry the point further. In such a case the act provides for appeal to be made by the workman within seven days after the refusal, through the registrar of the county court. The medical referee or surgeon, to whom the case is thus referred, would be

one of those appointed by the Secretary of State under the act. Among these appointees are some appointed for a particular disease, for example, as is the case for lead poisoning in the potteries district. The decision of the medical referee is final; but before giving it due notice must be sent by him to employer and workman of the date when the examination of the affected person is to be made, and he must consider any statements made or submitted to him by either party. Equally with the workman, the employer has the right of appeal to a medical referee, and, *mutatis mutandis*, precisely the same procedure might follow after the granting of the certificate, had the employer strong medical evidence that the workman was not suffering from plumbism.

Where Burden of Proof Lies

Where the lead poisoning is contracted by a person handling lead, as must necessarily be the case with a plumber, the act provides that it shall be presumed that the poisoning was due to the employment unless the employer can prove to the contrary. If, on the other hand, a miner were to urge a claim that he had contracted lead poisoning in the course of his employment, the burden of proof would rest on him.

Claims in Fatal Cases

Claims in the case of death, in default of agreement, must be settled by the county court judge, who may have the medical referee sitting with him as the assessor. Then arises occasion for forensic skill in argument as to whether the term "sequelae" in, for example, lead poisoning includes such associated conditions as chronic interstitial nephritis, and cerebral hemorrhage, or even phthisis, a disease of bacterial origin, to which the plumber has become more susceptible by reason of lowered vitality, the result of lead poisoning.

Sequela means the result or consequence, and its significance is such that, to quote a writer on the law of this subject, "If the applicant relies upon the sequelae of a scheduled disease as the immediate cause of death or injury, he must show that that sequela was in fact caused by the particular disease, and not merely that it was a possible sequela, or one common to that and other diseases; in other words, that the scheduled disease was the ultimate cause of death or injury. The court will not infer that a complaint which may be the sequela of more than one disease is, in the case before them, the sequela of a scheduled disease."

Personally, I hold that Bright's disease is in this manner clearly associated with lead poisoning. The mortality figure being 160 for lead workers as compared with thirty-five in other occupations (all males), it would be useless to endeavor to prove that any person suffering from Bright's disease, who has worked in lead for more than ten years, would have contracted it independently of lead. And naturally, if chronic Bright's disease is admitted, the train of symptoms associated with it — notably arterio-scelerotic changes, resulting in cerebral hemorrhage and albuminuric retinitis — must be admitted also. I should not consider that pneumonia or any acute disease of the heart or lungs, or valvular disease of the heart, or indeed any acute febrile condition can have direct relation with — i.e., can be a sequela of — lead poisoning.

Although we have thus followed the procedure of Section 8 in its application to one disease only — that which, by reason of the difficulty in diagnosis, is most frequently the subject of dispute — yet substitution in the text of lead poisoning by any other of the diseases (except eczematous ulceration, where burden of proof is entirely on the workman) would make no difference.

I have said that the committee on com-

pensation for industrial diseases was unable to recommend the scheduling of fibroid phthisis, which was the more unfortunate as they regarded it as a specific and distinguishable trade disease. A certain amount of relief was brought to the sufferer in the late stage of the disease when he was able to claim sickness insurance benefit under the National Health Insurance Act which came into force in 1912. The National Health Insurance Act, however, only deals with sickness, whereas the Workmen's Compensation Act takes into account death also, and the dependents of the person who has died from an industrial disease are able to claim a reasonable sum equal to the earnings of the diseased man during the three years preceding the injury, or the sum of £150, whichever is the larger, but not exceeding in any case £300. Pressure, therefore, continued to be made to bring fibroid phthisis under the Workmen's Compensation Act.

Since the English committee on compensation for industrial diseases reported in 1907, much has been done in South Africa on this subject. Before 1912 more than one committee of inquiry had sat in South Africa and had reported against dealing with the disease on the principle of the liability of the employer on which the English act is based. The South African commission reporting in 1912 concluded that the difficulties in the way of providing for compensation in South Africa were not as great as in the United Kingdom. In the first place, the disease, fibroid phthisis, develops much more quickly in South Africa, the time taken being from two to five years, and not from ten to fifteen as with us. Secondly, dismissal of the workman for pulmonary symptoms is very unlikely, as white labor is scarce, and therefore dismissal will hardly be practised before actual incapacity results. Thirdly, there was only one industry to consider, the Rand gold mining industry.

The principal act was passed in 1912 and was amended in 1914–1915. It provides for the establishment of two funds to which employers, workmen, and the state contribute, from which benefits are paid, and which are administered by a state-appointed board. The principal fund is the industrial fund to which the employer contributes $7\frac{1}{2}$ per cent. of the wages paid by him to miners, but recovers $2\frac{1}{2}$ per cent. from the worker. In addition, there is a compensation fund for cases in which application for benefit is made within two years of the commencement of the act and to this the government contributes, but this fund need not detain us as it is the insurance fund which bears the brunt of the compensation to be paid. The funds are administered and awards made (except in the case of native labor) by a miners' phthisis board appointed by the government. This now consists of seven members. The board is also empowered:

1. To acquire small holdings and establish beneficiaries and others on them.
2. To assist industrial undertakings which employ beneficiaries and their dependents.
3. To establish labor bureaus for obtaining employment for such persons.
4. To defray travelling expenses of beneficiaries to places of employment.
5. To collect statistics, etc., as to phthisis and the results of granting benefits.

Half the cost of (1) and (2) up to £20,000 a year is defrayed by the state. These additional duties were imposed on the board in accordance with the recommendation of a select committee that steps should be taken to obtain employment outside the mines for early cases and to combat the prejudice of employers against them. Most beneficiaries, they say, want work, not money.

All applicants for benefit are examined by members of a special medical bureau whose decision on purely medical questions is final. The bureau is paid partly by the

state and partly from the insurance fund. It was found desirable to place the examination of applicants in the hands of a few experts, chiefly with a view to avoiding divergencies of practice in examination. Under the regulations all examinations of "miners" take place, except in special cases, at the Institute for Medical Research and x-ray photographs are to be used at all such examinations. The bureau also conducts or controls all other examinations held under the act.

The extent to which physical capacity for work is impaired is the criterion for compensation, and not inability to earn full wages. The reason for this is that actual incapacitation from work at the usual wages occurs in the case of miners' phthisis at a very late stage in the disease, and that it is desirable to award benefit to the workman as soon as possible after, if not before, his capacity for work is impaired, and not to offer him any inducement to remain in the mines until he is absolutely incapacitated.

Every person desiring to enter for the first time upon work underground in a scheduled mine must, before he can be employed, obtain a certificate that he is free from any disease of the lungs and respiratory organs, and that he is physically fit for underground work. Further, a six-months examination of every person working underground is required, so as to make effective the law forbidding persons suffering from tuberculosis from working underground. No compensation for pure tuberculosis, seeing that it is not an occupational disease specific to the employment, is provided in the act. The contributions to the insurance fund amounted to £270,000 a year, representing $2\frac{1}{2}$ per cent. on the average working profits.

In New Zealand an attempt was made under the Workmen's Compensation Act of 1908 to include pneumonoconiosis (as affecting miners only) among the industrial diseases to which the act applied. In order to safeguard themselves to some extent against the liabilities imposed by the act, and as regards the liability to pay compensation in respect to pneumonoconiosis in particular, certain mine owners set up a system of medical examinations of employees and applicants for employment. Insurance companies refused to insure employers unless such a medical examination was established. The men objected very strongly to the examination (they actually laid the mines idle), alleging that it was degrading and meant that the less fit men would be out of employment, and further that it was abused as a means of getting rid of "troublesome" employees. It was also felt that the employers who first established such examinations were taking an unfair advantage of others by transferring to them the risk due to the employment of the less fit men. Subsequently, it was made illegal for the management to require employees or applicants for employment to be examined medically or to produce a satisfactory certificate. To make up for this, the employers pressed for the exclusion of pneumonoconiosis from the Workmen's Compensation Act and this was done. It may be observed that the disease was and apparently still is rare in New Zealand and that no claim for compensation in respect to it was made during the time the disease was under the act. Later, in 1915, what seems an extremely wrong principle was embodied in the Miners' Phthisis Act, when provision was made by the state to compensate miners incapacitated from work by miners' phthisis, as it holds out an inducement to continue in the mines until the disease is very advanced.

The way in which the compensation is now granted for fibroid phthisis in Great Britain is under an act called the Workmen's Compensation (Silicosis) Act of 1918. Under its terms, schemes can be provided

for payment of compensation by the employers of workmen in any specified industry or group of industries or processes involving exposure to silica dust, in the case of men affected by silicosis of the lungs or silicosis accompanied by tuberculosis. The scale of compensation fixed by the scheme in the case of death or total disablement is that prescribed by the Workmen's Compensation Act of 1906. Provision is made in the act for establishment of a general compensation fund, for requiring employers to subscribe to the fund, and for the payment and recovery out of the fund of all compensation and of any expenses arising under the scheme. Provision is also made for payment and remuneration of medical officers and advisory medical bodies, and for requiring workmen to submit themselves to periodic examinations (not oftener than once a year) and to furnish information with respect to previous employment in which there has been exposure to silica dust. Provision is also made for suspension from employment of workers who are found to be suffering from silicosis or from silicosis accompanied by tuberculosis. The first scheme has been prepared and made applicable to the refractory industries, and to all processes in, or in connection with, cutting, handling, breaking, crushing, grinding of material containing not less than 80 per cent. of silica, and in the manufacture of bricks or other articles made with silica. There are other occupations to which no doubt, in time, a similar scheme will be applied, as for example, dressing and grinding of sandstone wheels, grinding articles on sandstone wheels, and processes in pottery manufacture in which powdered flint is used. In this way such very large industries as the grinding of cutlery articles and stone-masons' work will be brought within the act.

POISONS IN THE RUBBER INDUSTRY*

The Rash Produced by Hexamethylene-Tetramine and a Means of Prevention

NORMAN A. SHEPARD AND STANLEY KRALL

From the Research Laboratory of the Firestone Tire & Rubber Co., Akron, Ohio

THOUGH the occurrence of a rash among rubber workers has long been observed it is only recently, since the introduction of organic accelerators of vulcanization, that the skin eruption or dermatitis has been at all serious or prevalent. By 1917, however, the problem had become so general that the Rubber Section of the American Chemical Society requested its Committee on Organic Accelerators to investigate the toxic properties of the more commonly used accelerators. The report (1) of this committee which was presented in September, 1918, at the Cleveland meeting of the society brought out the fact that most of the common accelerators had distinctly poisonous properties. The report covered aniline, paraphenylenediamine, thiocarbanilide, p-nitroso dimethylaniline and hexamethylene-tetramine; it emphasized the necessity of studying accelerators not only from the standpoint of the accelerating action but also as regards poisonous properties.

In the study of accelerators, the Firestone Research Laboratory has devoted much attention to the question of toxicity, with the purpose of finding an accelerator combining excellent acceleration with a minimum of toxic action. Knowing that many rubber companies are using hexamethylene-tetramine or "urotropin," it was thought that a study of the toxicology of this substance would be of interest not only to ourselves, but also to those who are already using this accelerator. The investigation has been extended to cover the probable cause of its action and to find, if possible, an antidote or simple means of prevention.

The action of hexamethylene-tetramine was summarized in the Report of the Committee on Accelerators as follows:

> *Symptoms of Poisoning.* — Rash and inflammation of skin which has been in repeated contact with stock containing this material. In severe cases, blisters filled with watery fluid result.
>
> *Antidote.* — Cleanliness and care in regard to clothing are the best preventatives. Change of occupation will cause the rash to disappear, leaving no permanent effects.

This description agrees closely with that taken from the United States Dispensatory (2) in which it is stated that, "Locally, hexamethylene-tetramine is mildly irritant and feebly antiseptic." "A measles-like rash with much itching has been noticed after its continuous use."

In order to study the nature of the irritation ascribed to this accelerator, the tetramine was applied in powdered form and in water solution of various concentrations to different parts of the body. Five men from the Research Laboratory were selected for these tests and applications were made on the wrist, forearm, chest and thigh. These applications were repeated several times each day for several days, yet there was no irritation or indication of rash in any case and not even the slightest itching. Thinking that possibly the perspiration might function in the production of this rash, applications were made on the feet and even under the armpits, where the perspiration flows most freely. Again, no action could be observed. Even applications following a very hot bath, thoroughly opening the pores and

* Reprinted from The India Rubber World, Nov. 1, 1919, 61, 75.

causing a typical "sweat," resulted in no irritation whatsoever.

As a result of these negative experiments, it was decided to introduce this accelerator into a factory compound in order to study its effect upon actual working conditions. The workmen handling this particular experimental stock were carefully observed. At the time this test was begun the weather was quite cool and for some time no deleterious effect was observed. However, with the approach of warmer weather the action of hexamethylene-tetramine began to manifest itself. It usually appeared first as a rash on the wrist or forearm, and in many cases was confined to these parts. The action became more pronounced, however, when really warm weather arrived; not only the forearms, but also the face and neck became involved and to such an extent in certain cases that a large portion of the face was affected, especially around the eyes. In general the inflammation was confined to the exposed parts, though occasionally it appeared on the shoulders, legs and even across the stomach. There seemed, however, to be no tendency for this rash to spread to any great extent beyond the parts which actually came in contact with the stock; the cases on the face and neck probably resulted from contact with the hands.

The dermatitis produced by contact with the stocks containing hexamethylene-tetramine was identical with that described by Kratz (3) in an article on the "Control and Prevention of a Rash Among Rubber Factory Employes," though his paper mentions no particular accelerator or other substance as the cause of the rash. Quoting from this article:

> The rash almost invariably appears as a simple erythema, such as is generally attributed to the heat. This condition is closely followed by the appearance of sac-containing eruptions or vesicles similar to those characteristic of ivy poisoning. These vesicles are quite small, seldom being larger than pin-heads and are grouped in varying arrangements, from being widely disseminated, to quite closely aggregated. They rarely retain their integrity for more than 48 hours, being broken by friction from the clothes or by the patient's rubbing and scratching, or, if this does not occur they soon become filled with a watery serum and rupture spontaneously in consequence of the exuded fluid.

The perspiration undoubtedly plays an important part in the production of this rash. It becomes almost epidemic with rise in temperature. Following a few hot or sultry days productive of profuse perspiration, a marked wave of rash will spread among the men handling the raw hexamethylene-tetramine stocks; a few cool days and it subsides, only to reappear again when the hot weather returns. This observation also agrees with that of Kratz, who writes:

> Though the rash is most prevalent during hot weather, particularly in humid midsummer, it certainly cannot be attributed solely to the heat; nevertheless the abnormal perspiration produced by the heat undoubtedly does play a part in rendering the skin most tender and susceptible to infection. Throughout the factory the fundamental cause of the rash will probably be traced to the irritation produced by the careless handling of green stocks or liners.

On studying the situation closely for several months and during the hottest weather, a marked immunity to the action of the hexamethylene-tetramine was observed. Only a small percentage of those handling the stock were affected. One would find next to an especially virulent case, men performing exactly the same operations and handling the same stock, absolutely free from any sign of irritation. This undoubtedly explains the negative results which were obtained in the laboratory when the strong solutions of hexamethylene-tetramine were first applied. In order to prove that the hexamethylene-tetramine was really responsible for the trouble, a patient was selected for experimentation from among those who had shown themselves susceptible to this rash.

This patient had had the rash very severely for nearly two months, the hands, wrists, forearms, face and neck all being involved. The part selected for the test with the concentrated accelerator was the arm above the elbow, where the skin was perfectly clear and where the patient said he had never had any rash. An application of a 50 per cent. water solution of hexamethylene-tetramine was made by moistening six plies of sterile gauze bandage with the solution and securing it with bandage and adhesive tape. This method of application was selected to insure constant contact with the skin and at the same time protect the treated spot from contamination with other substances. In the course of twenty-four hours, an eruption developed on the treated surface having all the characteristics typical of the "rubber rash." The other arm above the elbow was similarly treated, with the same result at the end of twenty-four hours. During these tests the forearms, face and neck on which the patient had previously had the rash were clearing up, showing that the rash above the elbow was not due to spreading from the forearms. No more applications were made for a period of eight days, at the end of which time the skin above the elbows had returned to its normal condition. Again, hexamethylene-tetramine was applied in 50 per cent. solution and again the rash was reproduced above the elbows. Two other patients susceptible to rash were similarly treated with this 50 per cent. solution; in both cases a rash was produced. All these tests were conducted while the weather was warm and the patients perspired freely while working. These results were so clean cut that they left little doubt as to the irritating action of hexamethylene-tetramine.

The absence of any rash, even on the hottest days, among those who handled the cured stock was very pronounced; as far as the writers are aware, not a single case was reported. In view of the recent work of Bedford and Scott on the "Reactions of Accelerators during Vulcanization" (4), this is readily explained. These investigators have shown that hexamethylene-tetramine reacts with sulphur at the vulcanization temperature, forming among other things, hydrogen sulphide, carbon bisulphide, ammonia and a sulphocyanate.

In order to determine a suitable substance to use as a preventive, an explanation of the mechanism of the action of hexamethylene-tetramine was sought. As the occurrence of rash is closely associated with the excretion of perspiration, the possible chemical changes which might result from its action on hexamethylene-tetramine were investigated. According to Schamberg (5) the perspiration is normally acid; this has also been demonstrated by actual tests by the writers. It is well known that hexamethylene-tetramine is readily decomposed by acids. Hartung (6) has shown that warming with strong acids results in the formation of formaldehyde, and more recently, Ischidzu and Inouye (7) have demonstrated that the weaker acids such as acetic, lactic and succinic acid bring about the same result; these investigators also showed that hexamethylene-tetramine is decomposed to some extent even on boiling the aqueous solution. Its use as a bladder antiseptic depends on the liberation of formaldehyde in the bladder due to the presence of acids in the urine; Suder (8) has shown that when the urine is alkaline this decomposition does not take place. It seems a logical conclusion, therefore, that when hexamethylene-tetramine is absorbed by the skin, formaldehyde will be produced in the pores under the influence of the sweat acids.

The corrosive and toxic action of formaldehyde has long been known. Remington and Wood (9) state that formalin is an intense local irritant both to the mucous membrane and, if in sufficient concentra-

tion, to the skin. It has been the writer's experience, however, that the action of a solution of formaldehyde is quite different from that produced by hexamethylene-tetramine. Application of 40 per cent. formalin produces a hardening of the skin followed by a scaly appearance due to cracking of the surface. This eventually peels off, leaving the lower skin perfectly clear. There is no reddening of the skin, nor any itching sensation.

Formic acid, on the other hand, is extremely irritative to the skin. On making an application of the strong acid, severe smarting and itching occur almost immediately, followed shortly by the production of a blister. After twenty-four hours the blister subsides and the affected spot has a pus-like appearance. A thick scab slowly forms and quite a perceptible scar remains after the sore has healed, showing that the acid burns quite deeply. The action of the formic acid resembles very much that of hexamethylene-tetramine, only very much intensified.

This study of the respective effects of formaldehyde and formic acid on the skin has led the writers to believe that the action of hexamethylene-tetramine is due to the formation of formaldehyde in the pores under the influence of the sweat acids, followed by subsequent oxidation of the aldehyde in the pores to formic acid, and that the latter is the active irritant. Though there is no proof that such an oxidation does occur in the pores of the skin, such an action seems not so improbable when it is considered that formaldehyde has been shown to be oxidized rapidly in the system, appearing in the urine as formic acid (9). The reason for the difference in action of formaldehyde as such and formaldehyde generated from hexamethylene-tetramine may be attributed to difference in absorption. Hexamethylene-tetramine is extremely soluble in water (1 part dissolves in 12 parts of water at 12°C.) which permits of rapid absorption through the pores. Formaldehyde, on the other hand, though very soluble in water, when applied to the skin quickly hardens the surface, making it impervious to further absorption. In fact, this property of formaldehyde has been utilized for the purpose of checking excessive perspiration (9).

On the assumption then that the acid of the perspiration is the primary cause of the rash, neutralization of this acid should prove an effective preventive, and furthermore, if the actual irritant is formic acid, neutralization of this would prevent its action, if it were formed. Any substance used to obtain this result should be itself non-irritating to the skin, preferably neutral in character, and sufficiently soluble in water to be easily absorbed by the skin. Sodium bicarbonate or "baking soda" meets all these requirements. It is neutral, quite soluble in water (100 parts of water dissolve 9.6 parts of the salt at 20°C.) and non-irritating, and consequently was selected for experimentation as a preventive means.

In applying the sodium bicarbonate, the method of treatment employed consisted in first thoroughly washing the affected part with soap and water, drying and then applying a saturated solution of the bicarbonate, allowing this to dry without wiping. The thorough washing opens the pores of the skin and allows better penetration of the bicarbonate wash. On drying, a white film of the salt remains as a thin coating which adheres with surprising tenacity. Two applications daily were made, at the beginning and at the middle of the shift. Before leaving the factory the affected parts were washed and no further application made at that time.

The first patient on whom this treatment was tried responded rapidly. The solution was applied to the arms, face and neck, all of which parts were affected. In the course of a week all the rash had completely disappeared, and what was of chief interest,

no new eruptions had developed. Since the weather was fairly cool during this period, it might be concluded that this was the cause of the rapid disappearance of the rash. To prove otherwise and eliminate the temperature factor, the use of the wash on the left arm was discontinued while continuing the application to all the other exposed parts; five days later the left arm, and the left arm only, was broken out with the typical rash. Thinking possibly that this might be due to more frequent contact with this arm with the stock, the treatment was omitted from the right arm and again continued on the left. Four days later an eruption appeared on the right arm, while all the other parts treated with bicarbonate were entirely free from any dermatitis. This patient used bicarbonate for a period of four weeks and during that time had no sign of rash except on the forearms when the wash was omitted as previously mentioned. Before using bicarbonate, this patient had had the rash on some exposed part of his body almost continuously for nearly three months.

A squad of ten men was selected for further tests as to the efficacy of the bicarbonate solution. These men, selected from the various departments handling this stock, had all been troubled more or less severely with rash. This squad was supplied with the bicarbonate wash and carefully observed from day to day during a period of two weeks. All, without exception, showed marked improvement; the old rash healed rapidly and no new eruption developed. During the course of these observations there were several very warm days, which brought on quite a wave of rash among those not being treated. Not one member of the squad, however, developed any rash during this hot spell.

On the strength of these results bicarbonate solution was provided, so that all the men handling the raw stock containing the hexamethylene-tetramine could obtain it if troubled with this rash. Though it was not possible to obtain as accurate data on all those applying the solution, the reports obtained from both the foremen and the men using the solution were very encouraging.

At the Eighth Annual Congress of the National Safety Council held at Cleveland on October 4, 1919, a representative of the Hood Rubber Company stated that they had had very considerable success in combating this rash by using an aqueous solution of borax containing gum arabic. He stated that this mixture dried with some difficulty, and they had installed electric dryers to obviate this trouble. Though the writers have not had opportunity to test this treatment, they feel that the bicarbonate solution offers a much simpler treatment; it dries readily, is free from the alkaline reaction of borax and in addition costs very much less.

While it is true that the necessity for the application of any preventive or prophylactic solution, such as bicarbonate of soda or borax, is a serious drawback to the use of a substance as an accelerator, it does not prohibit its use. It offers a better solution of the difficulty certainly than that offered by the Committee on Accelerators. "Change of occupation," with the entailed loss of wages and curtailed production, can scarcely be considered a satisfactory antidote, either from the standpoint of the employee or employer.

The use of the bicarbonate solution is attended with no disagreeable results. When first applied to a severe case there is considerable smarting, but this soon stops after the solution has dried and the patients report that the severe itching which always accompanies this rash is relieved within a few hours, and there is a marked improvement in the appearance of the skin after twenty-four hours. The solution can be applied to the face and neck and even around the eyes with perfect safety. This

is of particular importance, as some of the most severe cases are those in which the face, especially around the eyes, is affected. A case which recently came within the observation of the writers was that of a man whose entire face was inflamed to such an extent that both eyes were completely closed. Not only was the face affected, but also the arms, shoulders and legs. This case was so severe that it was found necessary to put the patient to bed. Four hours after the first application the inflammation had subsided, the patient stated that the itching sensation was practically gone and he was able partially to open his eyes. At the end of ten hours he was quite comfortable and slept through the entire night. This was quite remarkable for those suffering from the rash complain chiefly of being kept awake at night. Thirty hours after the first treatment he had sufficiently recovered to be discharged from the hospital.

Though the bicarbonate has an apparent curative effect, it is unquestionably chiefly preventive. The case just cited seems to contradict this, but the writers feel that the curative action was simply due to arresting the further action of the absorbed hexamethylene-tetramine. The chief interest in this treatment is the fact that further development of new rash is prevented, and the old rash is thus allowed to heal without further infection.

These observations are published with the realization that they represent the action of bicarbonate on a comparatively small number of cases, but the results seem to justify the conclusion that bicarbonate can be used successfully in controlling the hexamethylene-tetramine rash.

In presenting this paper the writers wish to acknowledge their appreciation of the co-operation of both Dr. D. V. McDonald, medical director, and John Young, chief chemist, of the Firestone Tire & Rubber Company.

BIBLIOGRAPHY

1. Report of the American Chemical Society Committee on Organic Accelerators. Jour. Indust. and Engin. Chem., 1918, **10**, 865; The India Rubber World, 1918, **59**, 82.
2. United States Dispensatory, Fifteenth Edition, p. 611: Twentieth Edition, Philadelphia, 1918, p. 545.
3. Kratz, G. D.: Control and Prevention of a Rash among Rubber Factory Employes. The India Rubber World, 1917, **57**, 145.
4. Bedford and Scott: Reactions of Accelerators during Vulcanization. Presented at the fall meeting of the American Chemical Society, Sept., 1919.
5. Schamberg, J. F.: Diseases of the Skin and the Eruptive Fevers, Philadelphia, p. 26.
6. Hartung: Jour. Prakt. Chem. (2), 46, 16.
7. Ischidzu and Inouye: Jour. Pharm. Soc., Japan, Jan., 1906.
8. Suder: U. S. Dispensatory, Fifteenth Edition, p. 611.
9. Remington, J. P., and Wood, H. C., Jr.: U. S. Dispensatory, Twentieth Edition, Philadelphia, 1918, p. 638.

BOOK REVIEWS

The Action of Muscles. Including Muscle Rest and Muscle Re-education. By William Colin Mackenzie, M.D., F.R.C.S., F.R.S. (Edin.), Member of the Council of the Anatomical Society of Great Britain and Ireland and of the Staff of the Military Orthopedic Hospital, Shepherd's Bush, London; formerly Lecturer on Applied Anatomy to the University of Melbourne, and Examiner in Senior Anatomy to the Universities of Melbourne and Adelaide. Cloth. Pp. 267, with illustrations and index. New York: Paul B. Hoeber, 1918.

This is a comprehensive study of muscle as an organ of motion. Great emphasis is laid on the mechanical factors generally overlooked by physicians. For instance, the joints of the body are described as levers of the first, second and third orders according to physics, and figures are given showing examples of each order and explaining the special mechanical advantages of each.

The most practical part of the book is that describing muscle rest, in which a new point of view is brought forward that rest is the essential treatment for paralysis and that the old fallacy that we must do something to the muscle to maintain its nutrition would appear to be dying as hard as the one that by resting a joint its liability to ankylosis is increased. It is even claimed that rest is essential for the repair of the nerve cells connected with the muscle, and that massage and electricity interfere with recovery.

The "zero position" is described as that position in which the antagonistic muscles at a given joint are at equilibrium, and are so balanced that neither has a mechanical advantage over the other. This intermediate position is the ideal one for rest, and whenever a muscle is paralyzed the antagonist must be kept from overaction by placing the joint in this zero position by means of splints. Many such splints are illustrated in the text and examples of war wounds are shown. In testing for the presence of voluntary motion in a muscle, it is imperative that the muscle should first be put in this zero position, otherwise slight voluntary motion may be present but not elicited on account of gravity, friction, or the overaction of the antagonist, masking the slight power of the muscle tested. For example, in deltoid paralysis the patient should be lying flat with his arm on a smooth, powdered surface, so that abduction can take place without working against either friction or gravity, and the pectoralis major must not be allowed to contract and thus counteract this abduction.

Many references are made to comparative anatomy, and the author shows a wide knowledge of the myology of marsupials. The arguments are, however, often teleological and not convincing. Special muscle groups are thoroughly discussed: the shoulder region, the muscles of the thigh, muscles acting on the leg, muscles acting on the foot, are all taken up in detail, and special nerve paralyses are described and methods of treatment outlined.

If the physiological contentions can be borne out by experiment, the book is a most useful one, for the methods of treatment given seem to have stood the test of trial and to have given better results than older methods. For anyone desiring to acquaint himself with the specific function of any muscle or group of muscles the book is valuable. — *Stanley Cobb.*

The Organization of Public Health Nursing. By Annie M. Brainard, Editor-in-Chief, Public Health Nurse, Cleveland, Ohio. Cloth. New York: The Macmillan Company, 1919.

The Organization of Public Health Nursing, recently brought out by The Macmillan Company, is a book that will prove of interest to community workers everywhere. To public health nursing associations it is exceedingly valuable for in it Miss Annie M. Brainard has collected and presented recent methods of managing the community health work which falls so largely to the charge of the visiting nurse, whether in her capacity of district nurse, school nurse, tuberculosis nurse, industrial nurse, or well-baby nurse. In her introduction Miss Mary Gardner says: "If the public health nurse is to fill adequately the important position in this general public health movement now assigned to her, an increasing effort must be made to so organize her work as to remove all unnecessary friction from the wheels of administration. Miss Brainard, after a long experience in the public health nursing world, in a city notable for its organized health effort, is in a position to state clearly not only the general principles underlying all forms of systematized organization, but is also able to place at the disposal of those unused to such work, valuable

suggestions regarding simple matters of detail on which depend success or failure."

Without an intimate knowledge of public health nursing, one can hardly appreciate how little uniformity of administration for any type of such nursing is in existence. For instance, school nurses in one large city are directed under a totally different policy from that of another city, and it may be, by quite another department of the municipal organization — the department of health and the board of education, for example, each claiming the responsibility.

Miss Brainard says: " First of all there is the National Organization for Public Health Nursing, which in a certain way forms a background for all the work carried on in any part of the country. I say ' in a certain way,' for it is not like the organization of Queen's Nurses in England, nor the similar Victorian Order of Nurses in Canada. It does not train the nurses, nor does it employ them or supervise their work. There is no central authority. Membership in the National Organization for Public Health Nursing carries with it nothing beyond a recognition of standard, and the Organization itself is purely one for upholding these standards; giving help and advice to individuals or communities; assisting in the spread and establishment of Public Health Nursing; and for keeping up an historical record of the work and its growth."

As we go on reading we are led not only to review established methods of organization with valuable detailed accounts of the many committees which such organization implies, but also to look ahead to the broad new implications of public health nursing development. Such a looking ahead is found in the treatment of advisory committees of lay persons sometimes attached to city or state departments of health (Chapter III, p. 30 and Chapter VI, p. 64); such is the treatment of school nursing, in relation to the health administration; and of the importance of making a close affiliation between departments of health (local, state, or federal public health service) and all other public health nursing organizations, even though they are privately controlled.

The question of " generalized " nursing is discussed (Chapter III, p. 25), and " in theory at least " it is conceded that the " ideal plan for public health nursing in a city " is to have " one nurse in a small district, under one central control with specific supervision of specialties."

In a rather unusual way this book has dealt with many small concerns of public health nursing administration and has never at any time submerged the greatness of the cause in these details. We lay the book down with a distinct desire to be a part of that organization upon which the value and success of public health nursing so largely depend. — *Mary Beard.*

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | JUNE, 1920 | NUMBER 2

ETHER POISONING IN THE MANUFACTURE OF SMOKELESS POWDER *

ALICE HAMILTON, M.D.
Special Investigator, United States Bureau of Labor Statistics, and Assistant Professor of Industrial Medicine, Harvard Medical School

AND

GEORGE R. MINOT, M.D.
Assistant Professor of Medicine, Harvard Medical School

THE SMOKELESS POWDER INDUSTRY †

SMOKELESS powder,‡ pyroxylin, pyro powder, is guncotton dehydrated and reduced to a colloid condition by means of ethyl alcohol and sulphuric ether and then pressed and cut into appropriate shapes. It is not powder at all but looks like chopped, dark brown or black macaroni, spaghetti, or vermicelli, according as it is intended for use in large or small ordnance. During the manufacture there is one stage, block breaking, at which strong fumes of ethyl alcohol are given off, and two stages, mixing and pressing, at which the fumes of ether are strong. Yet in spite of the fact that smokeless powder has been made in all civilized countries for many years and was manufactured on an enormous scale during the war, there is practically nothing in the literature about ether as an industrial poison. The report of the Chief Medical Inspector of Factories and Workshops for the year 1918 mentions it, but only to state that the women who were introduced into smokeless powder works in England during the war suffered so much more severely from ether fumes than the men that it was necessary to give up employing them and put men in their places.

In the course of an investigation of industrial poisons in the making of explosives, which the U. S. Bureau of Labor Statistics undertook in the spring of 1916 (*Bulletin of the U. S. Bureau of Labor Statistics No. 219*, pp. 54 and 72), nine factories making smokeless powder were visited and an attempt was made to discover how much, if any, damage to health resulted from the breathing of ether fumes. At that time only men were employed in smokeless powder manufacture. After our entrance into the war, when it became necessary to substitute women for men in many occupations, a second inspection of

* Received for publication Feb. 21, 1920.

† By Alice Hamilton.

‡ Smokeless powder is not classed as a high explosive, being a product of lower nitration, containing about 11.5 to 12.5 per cent. of nitrogen. The high explosive powders, known as mixed powders, of which cordite is the best known, are made from nitro-cotton of higher nitration containing up to 13.5 per cent. nitrogen. These are mixed with nitroglycerin and sometimes acetone and vaseline to form colloided strips. These powders are not soluble in ether alcohol.

these plants was made, because it so happened that since the work in the ether department was light and easy this department was the very one in which women's labor could best be used. By the spring of 1918 several hundred women were doing this work.

About this time the National Research Council decided to make some studies on the subject of munition poisons, and, among others, on the effect of long continued exposure to fumes of ether. A smokeless powder plant was selected in which conditions were as good as they could possibly be during summer weather, and a woman who had been the technician in charge of the clinical laboratory of the University of Wisconsin Hospital, Mrs. H. M. Fogo, was sent to the plant to take the clinical histories of the women in the ether department and to make routine examinations of blood and urine.* Mrs. Fogo remained at the plant during July and August, 1918. Her blood findings, which are described in Dr. Minot's section of this paper, were interesting and seemed to call for additional tests to check them up and to supplement them. The National Research Council planned to have this additional work carried on in the same plant and on the same individuals, but before the arrangements were completed the signing of the armistice put an end to the employment of women in this and other smokeless powder works. The manufacture was at once greatly curtailed and the only available subjects for such a study were a small force of men in another plant. These men were a selected group, retained because of their skill and experience, and their willingness to remain showed that they did not suffer much discomfort from the ether fumes. Shortly after the armistice two selected students from the Harvard Medical School went to this plant and studied the condition of these male workers. The results obtained from the two groups, women and men, are not really comparable for the women had been employed only a short time — less than half of them as long as six months — and were not selected, since the oversusceptible had not been dismissed. The men, on the other hand, were mostly old hands with probably either natural or acquired immunity. These differences must be borne in mind in considering the data given below as well as in considering Dr. Minot's report of the blood findings in the two groups.

The processes involved in the manufacture of smokeless powder may be briefly described as follows:

1. Centrifuging the wet guncotton to get rid of the water.
2. Dehydrating, by forcing denatured alcohol through the guncotton in a hydraulic press.
3. Breaking up with wooden hammers the block which comes from this press.
4. Mixing the fragments with the solvent, ether alcohol.
5. Pressing the colloided product into a block.
6. Forcing the block through dies from which emerge long, perforated strings of different diameters.
7. Passing the strings through openings in a cutting machine to be cut into the required lengths.

After this, the so-called powder goes to the solvent recovery house where the ether is evaporated off and collected for further use, and then to the blending towers, but neither of these departments concerns us as they do not expose the workmen to fumes.

The processes described above are carried on usually in separate buildings and there is a high standard of cleanliness, necessitated by the explosive character of the dust. The problem of ventilation is rather difficult. Both alcohol and ether being inflammable in vapor form, great precautions must be taken to prevent overcharging of the air with vapors. In the block-breaking department where alcohol

* This investigation was made possible through the courtesy of the E. I. du Pont de Nemours Company, for whose assistance and co-operation the Committee on Munition Poisons of the National Research Council desires to express its gratitude.

fumes are given off it is easy to prevent an excess of fumes because the work is usually done in a small separate building with a wide window and door, yet it is not rare to find cases of at least slight alcoholic intoxication among the men who do this work. The mixing with ether alcohol is carried on in bread-kneading machines, usually in a long narrow building with a wide door in front of each machine and a window behind. The ether and alcohol are run in from a hose and then the machines are tightly closed during mixing but must be thrown open at the end when the men dig out the mixed cotton. During this time the air gets very heavy with ether, and in order to get at the last part of the charge the workman has to lean far over with his head inside the opening. To the observer this work seems to be attended with exposure to very unpleasantly strong ether fumes, but this exposure is not continuous and it is the unanimous testimony of workmen, superintendents, and company physicians that the amount of ether poisoning is insignificant in this department compared with the next, the pressing and cutting department. Eight times as much of the solvent is said to be lost in pressing and cutting as is lost in mixing.

The cotton and solvent from the mixing machine goes to a block press — " preliminary block " — and comes out a colloid mass, looking like crude rubber. This is pressed through a " strainer," a series of metal screens to remove impurities, out of which it emerges in long strings. These are pressed into the " final block " and the block is driven through a die precisely as is the dough for macaroni and spaghetti, and in the same way cords are formed of a thickness varying from that of coarse macaroni to the finest vermicelli, all perforated with tiny canals running the length of the string. The strings fall into fiber pails which are carried to the cutting machines in the same room, and each string is passed into an opening in the latter. It is here that very appreciable quantities of ether are given off and where the trouble from ether poisoning is greatest.

The pressing and cutting department cannot always be freely ventilated, as can the mixing, because the temperature must always be maintained at about 75°F. and therefore the windows can be wide open only in warm weather. Since ether fumes are heavy, the method of ventilation adopted is the delivery of heated air through pipes near the ceiling and the provision of vents at the floor level. I never saw suction applied to these vents and the ventilation was never good on hot and humid days in summer or in cold weather. It was only when my visit was paid on a fresh day in fall or spring, when the difference between indoor and outdoor temperature was just right, that I found the air in a pressing and cutting department quite tolerable. The men themselves always say that ether poisoning is worst in winter when all the windows are shut, and next on heavy, windless nights in summer.

Ether is expensive and the more progressive manufacturers made great efforts during the war to prevent its loss but with little success until late in the summer of 1918, when a method was devised for collecting the vapors from the bottom of the receptacle into which the strings of powder fall from the pressing machines. This was, however, too late to affect conditions in any plant but one.

The investigation made by the U. S. Bureau of Labor Statistics in 1916 disclosed the fact that acute ether intoxication was notorious among the men employed in the pressing and cutting departments, less so among the mixers. The ether departments were far from popular and there was a great labor turnover, especially in pressing and cutting, so that it was difficult to find men who had been at such work long enough to throw any light on the effect of

long-continued exposure to the fumes. To quote this report:

New hands suffer a good deal from mild ether poisoning. They pass through all the stages of narcosis as they are known to the anesthetist, the gradually increasing confusion, excitement, which may make the man almost uncontrollable for a short time, then the gradual dulling of the senses and drowsiness, passing into stupor and unconsciousness. The physician, even if he be on the grounds, seldom sees the man in the stage of excitement; usually by the time he has reached the office he is already stupid. There is no treatment for this condition, beyond allowing him to sleep it off in fresh air. Occasionally cases are sent to hospitals, if the narcosis is unduly prolonged, and we have the record of one case in which unconsciousness lasted for twenty-four hours. There may be heart symptoms needing medical care, for a very rapid pulse is not uncommon.

The two most serious cases of ether poisoning which came to our knowledge were lads who had recklessly exposed themselves to ether fumes for several hours. They had gone into one of the small buildings where ether is condensed from smokeless powder — "solvent-recovery houses," they are called — and had climbed up on one of the solvent-recovery bins where it was warm and comfortable. They lay down near a manhole which was supposedly well closed with a rubber gasket, but there must have been some escape of fumes, for after reading a while they both fell asleep. They were found after they had been there less than an hour and a half, and both were in an alarming condition — respiration only 6 or 8 a minute, pulse down to 30. Two hours' work with the pulmotor brought them around and they were apparently none the worse for their experience.

The usual after-effects of ether anesthesia follow ether poisoning in industry. The next day the man is somewhat nauseated, has headache, cannot eat, is generally wretched, and has pains in his back. Often he becomes accustomed to the fumes and does not seem to be injured in any way by repeated exposures of many hours each day.

On the other hand, there are men who cannot get used to it. The physician in charge of one of the largest smokeless powder works said that he had frequent requests for transfer from the ether men, but that he always convinced himself that the man was really ailing before he would accede to his request. The same morning he had just issued a transfer to a man who had symptoms of nephritis. This is not, in his opinion, a frequent sequel of long-continued exposure to ether fumes, but it may occur, and it would be a good thing if it were possible to make an examination of the urine of all men applying for work in this department.

A case of chronic ether poisoning was reported by a physician practicing in the neighborhood of this same plant. The man had worked there for three months and was then suffering from albuminuria and puffed eyelids. He had never had these symptoms before.

Another form of chronic ether poisoning affects the digestion and general nutrition chiefly. A man who had been in charge of smokeless powder works for six months gave his symptoms as follows: He lost his appetite, partly because he always had a taste of ether in his mouth. His breath smelt of it all the time. After about three months of this work he began to grow apathetic and listless. He felt tired out and was chronically constipated. He lost 20 pounds and decided to leave the place. After taking up other work he was still constipated for several months, but his appetite came back and gradually he regained his normal condition. Another man, a workman in the pressing and cutting room, had also had to leave on account of his health. He said he would feel at first very much exhilarated, "as if I were walking on air or had a million dollars," and then depression would come on, especially when he went home. He, too, found that his digestion and nutrition were seriously impaired.

Most physicians and practically all superintendents and foremen believe that if a man can become accustomed to the ether so that he no longer gets a "jag," or only rarely, he will not be injured in any way by months or even years of such work. They point to the fact that some of the ether men actually gain in weight under the influence of the work.

The government report also speaks of the combined effect of alcohol and ether on smokeless powder men. The largest plants visited are situated directly across the Delaware from Wilmington in a prohibition territory, while Wilmington at that time was "wet." The powder men would often go over to Wilmington just after their work, would take a drink of whiskey or a glass or two of beer and almost at once become completely intoxicated, "dead drunk." Many of these men were taken to the workhouse and there they would scent the whole place with ether, their breath was so heavy with it. At first the magistrate was sceptical when told that the man who

had been found by the police dead drunk had only had a couple of glasses of beer, but later on it became generally accepted that such a condition was to be looked for in the powder men.

When the National Research Council took up the investigation of ether poisoning in smokeless powder manufacture in July, 1918, the work of pressing and cutting had passed in all the important plants into the hands of women and girls. In the factory selected for study, eighty to ninety women were employed during the summer months and came under the observation of the investigator. None of them had worked as long as one year. The majority had not worked six months. They were between the ages of 16 and 36, thirty-nine being under 21 years. Forty-seven had never done factory work before.

The work in pressing and cutting was light and easy with the single exception of lifting the 75-pound block into the pressing machine which was still done by men. The women took the strings from the pressers and passed them into the openings of the cutters. They worked in eight-hour shifts and as two shifts were omitted on Sunday, each woman had a full day's rest in seven and no one had to work a double shift when changing from day to night. They had many advantages as compared with the men who had preceded them; they were housed in excellent dormitories, if unmarried, or in the well-built company village, if married. The food furnished in the company restaurant was very good and even their recreation was carefully planned. The medical supervision provided was far more careful than that given to the men and the women were encouraged to go at once to the first-aid department if they experienced any real discomfort from the ether. In the two best plants it was customary to distribute hot coffee during the night shift, for it was on this shift especially that the women were likely to be overcome by the fumes. They were of a decidedly higher class than the men, some of them having gone into the work from patriotic motives. Another great advantage was their freedom from indulgence in alcohol.

The blood findings in this group of women are given later by Dr. Minot. Tests for the presence of sugar and albumin in the urine, which were made in fifty-five cases, gave negative results except for a slight trace of albumin in one and a more decided trace in two more. Two of these women were in perfect health, the third was suffering from symptoms of ill health which dated from her present employment. She had lost weight during her seven months of ether work, had lost appetite, suffered from nausea and occasional vomiting, was constipated, and felt drowsy while in the ether fumes.

Acute intoxication, "ether jag," had been experienced by forty-eight of the eighty women. Thirty-one had only one such attack, seventeen had had from two to many attacks. One girl had been overcome eight times in four months, another twelve times in six months. In addition, seventeen girls who never had a typical "jag" suffered more or less frequently from attacks of dizziness and faintness so that the number experiencing acute effects from the ether fumes was sixty-five, or 81 per cent.

The girls described their symptoms in different ways: "I felt sleepy and cross and wanted to fight some one"; "I felt very happy. I laughed and sang and wanted to keep on working, but they made me go out of doors"; "Sometimes I am happy and sing, sometimes I have to cry, and once I fainted away"; "I began to cry and I couldn't stop, so they took me to the hospital and there I was nauseated and sick for an hour, and for a week after I did not want to eat anything"; "I was dizzy and faint and when I tried to lift the powder I could not move my arms"; "I was

pushing a car along a runway and I kept getting drowsier all the time, then they brought the hot coffee around and I drank two cups and this drove away the drowsiness, but I became very much excited, and insisted on pushing the car the wrong way so that the foreman could not do anything with me, and had to get another girl and send me out of the building. Two girls fainted away that night."

Out of the group of eighty women, thirty-one made complaint of loss of health or of discomfort of some kind which seemed to be attributable to their exposure to the fumes of ether. One of the most common symptoms was loss of appetite, especially for lunch — they said they could not eat immediately after leaving the ether fumes. A few had at first eaten ravenously but this was soon succeeded by a distaste for food. Some of the girls said they would grow very thirsty while at work but dared not take a drink of water for it would bring on vomiting. Twenty complained of attacks of nausea and seven had actual vomiting. Faintness and dizziness were fairly frequent, thirty-five of the eighty making this complaint, although not all of these were suffering from real impairment of health; in some instances these were the only symptoms complained of. Constipation was brought on or increased by ether work in twenty-eight. Twenty-three said that they were losing weight. Drowsiness while at work was often troublesome and the girls on the night shift depended on strong coffee to keep them awake. Five had disturbed sleep but thirty-one slept more than ever before, some of them twelve, fourteen or even fifteen hours — practically all their spare time.

The following is a typical history:

D. S. is twenty-one years old and worked in a factory before coming here. She has been working in smokeless powder for nine months and is troubled with sick headache and a feeling of faintness most of the time, pain in her chest, and burning in the throat. About three times a week she has an attack of weakness, dizziness, faintness, nausea and depression, which is worse when she is on the night shift. She has no appetite, never touches her lunch and has lost sixteen pounds. She is too nervous to sleep well, averaging only four or five hours a night. Her cheeks used to be rosy but now her face is sallow and sometimes covered with a red rash.

This last symptom was mentioned by several of the girls. It seemed to be an itching eruption on the face, caused by the ether fumes, for it sometimes appeared only on the side of the face which was nearest to the cutting machine. The holes in the cutting machine through which the strings of powder were passed were about at the level of the girl's eyes.

On the other hand, forty-nine girls insisted that they were quite as well as before, with the exception in some cases of an occasional attack of fainting or of an "ether jag"; nine were gaining weight and seventeen said their appetite was better than ever before. It was evident that the susceptibility to ether fumes varied very decidedly among these girls. When the histories of those longest employed were selected, they were found to fall into two groups of equal size, one consisting of women who were not at all inconvenienced by their work or who suffered nothing more serious than occasional dizziness and faintness on a hot day, and the other of women who were apparently losing health and strength as a consequence of their work. Of the thirty-two women who had done ether work for more than six months, sixteen belonged to the group of immunes, and sixteen to the susceptible group.

The second study, made after the armistice, included thirty-five men between the ages of 19 and 50, the majority of them between 27 and 37 years of age. A complete physical examination was made of these thirty-five men, and no positive findings were obtained which could be definitely referred to ether. However, in four men the liver was just palpable. In one of these men,

one who was recovering from mild acute poisoning, a large trace of albumin was found in the urine. The examinations for albumin and sugar were negative in the other workers and the urine sediment which was examined in several cases was found not abnormal. Blood pressures were within normal limits.

A much smaller proportion of the men than of the women in the former group had felt the acute effects of the ether. While forty-eight of the eighty women had been "etherized" only nine of the thirty-five men had experienced any acute discomfort of this kind, and four of these described it as only a slight exhilaration when the ether was strong, not severe enough to make them stop work.

Aside from symptoms which were referable to acute ether poisoning, certain other symptoms were elicited by questioning. Twelve men complained of increased thirst, definitely greater than when they were doing other work. Six complained of lassitude, five of palpitation of the heart, but usually only when the ether fumes were strong. Three said that they had specks before the eyes, four had a feeling of numbness in the fingers and one, numbness or burning in the feet. Eighteen had, so far as they knew, neither gained weight nor lost, but thirteen had lost from 5 to 25 pounds while engaged in this work. These men had been employed from ten months to seventeen years, only four of them for less than three years. On the other hand, four men who had worked, respectively, for two months, three years, five years and nine years claimed to have gained from 2 to 20 pounds in weight.

THE BLOOD OF INDIVIDUALS CHRONICALLY EXPOSED TO ETHER *

Preliminary observations on the blood of fifty-one individuals chronically exposed to sulphuric ether fumes were carried out by a qualified technician, Mrs. H. M. Fogo, under a grant from the National Research Council. The individuals examined were all young women between the ages of 16 and 30; over half were under 22 years of age. Analysis of the data obtained by Mrs. Fogo shows that in over half of the workers the number of red corpuscles was above 6,000,000 per c. mm., a figure distinctly above normal for women, who in general have lower red counts than men. The red counts obtained in these fifty-one individuals are summarized in Table 1. Mrs. Fogo made control counts of the red cells on healthy young women in the same locality as the ether workers. These control counts varied between 4,700,000 and 5,300,000 cells per c. mm.

The hemoglobin determinations on these ether workers were not entirely satisfactory but it may be stated that, on the whole, the hemoglobin averaged, relative to the red counts, distinctly low; namely, about 80 per cent.

TABLE 1. — RED COUNTS OF FIFTY-ONE WOMEN EXPOSED TO ETHER FUMES

Number of Cases	Red Counts in Millions
3	7.5 to 7.8
4	7.5 to 7.0
14	7.0 to 6.5
10	6.5 to 6.0
14	6.0 to 5.5
4	5.5 to 5.0
2	5.0 to 4.5

The white counts as a rule were above normal. They averaged 11,000 cells per c. mm., there being two cases with counts as high as 16,000 and two as low as 6,800. The white counts bore no definite relation to the level of the red counts. Detailed examination of the red cells, white cells and platelets, as well as other observations on the blood, were unfortunately not made in this series.

* By George R. Minot. From the Medical Clinic of the Massachusetts General Hospital and the Department of Medicine of the Harvard Medical School.

The symptoms which this group of young women exhibited have been referred to by Dr. Hamilton. From the data available, there appears to be no clear-cut relation between the red counts and the symptoms.

Because of the increased red counts in these women, a further examination of individuals constantly exposed to ether fumes was undertaken under the auspices of the National Research Council. This work was conducted under my guidance by two specially qualified medical students, J. B. Garland and Roy A. Wheeler. The

TABLE 2.—RED COUNTS AND HEMOGLOBIN PERCENTAGES OF THIRTY-FIVE MEN EXPOSED TO ETHER FUMES

Number of Cases	Red Counts in Millions	Average Hemoglobin Percentages
2	6.5 to 6.7	76
5	*6.2 to 6.0	
5	6.0 to 5.5	88
17	5.5 to 5.0	82
6	5.0 to 4.6	76

* There are no cases with counts between 6.2 and 6.5.

thirty-five employees available for the study differed materially from those of the first series, in that, instead of being young girls, they were mature men averaging about 32 years of age. In the following sense, moreover, this group of men represented selected individuals. Shortly before the study was undertaken, a large cut had been made in the number of persons employed in the department of the factory where the exposures to ether occurred, so that the men who were examined had either volunteered their willingness to continue work or had been selected as particularly skilful. The majority of these men had been in work exposing them to ether fumes for over three years, while most of the women of the first series had been exposed to ether fumes for less than six months, and none for a year. The men had definitely fewer symptoms from ether than the women. This fact has been referred to by Dr. Hamilton.

The red counts and the hemoglobin percentages (Sahli)* of these thirty-five men are shown in Table 2. (More than one count was made on some cases; fluctuations occurred but none were great.) Detailed microscopic examinations † of the red cells showed that they were slightly but definitely abnormal in about 20 per cent. of the cases. Their abnormality consisted in the existence of some achromia and of slight but definite abnormal variation in size. Occasionally an abnormally shaped cell was seen, and rarely a polychromatophilic cell. No microcytes occurred nor were other abnormalities noted. The reticulated red cells occurred in normal numbers. There was a rather definite tendency, though exceptions occurred, for the cases with the higher and the lower red counts to show abnormality of the red cells, rather than for the individuals with red counts between the extremes. This is consistent with the fact that anemia, as determined by the diminished amount of hemoglobin per unit of blood, was particularly present in the cases with the highest and the lowest red counts.

The white counts in the thirty-five men averaged 9,500 cells per c. mm. There were six cases with counts between 12,000 and 16,000 and seven with counts between 5,000 and 7,000. There was no definite relationship between the white counts and the height of the red counts. Differential counts of the white cells showed the polynuclears between 70 and 80 per cent. in seven cases and between 48 and 54 per cent. in four cases. There was a rather definite tendency for the higher polynuclear counts to occur with the higher red

* In a series of twenty clinical cases, normal and anemic, in the wards of the Massachusetts General Hospital, the hemoglobins, as estimated by the same Sahli instrument, were 16 to 26 per cent. lower than when determined by Palmer's method. Normal controls with this same Sahli instrument showed a hemoglobin of 85 to 96 per cent.

† The blood preparations were all critically studied by myself but important assistance was given by Miss Margaret Weld in studying them.

counts. Slight increases of large mononuclear cells were seen in some instances.

The blood platelets, as estimated from the fixed smears, occurred in essentially normal numbers, the tendency, perhaps, being toward a very slight increase.

In general, the blood examinations of these men did not show any striking abnormality. The red counts alone could perhaps be considered merely as high normal figures, though it does seem unusual to find among thirty-five men seven who had red counts of over six million. Many of the red counts were certainly well above normal in the women workers, which suggests that the higher counts in the men were due to the same cause. One may explain the observation that the men showed fewer blood changes than the women on the ground that they had not been affected by the ether to the same degree — a probability supported by the fact that the women had decidedly more symptoms than the men. This may have occurred because the men were selected individuals less susceptible to ether, or perhaps because they had developed an immunity to ether, or possibly because they received less of the substance.

The various possible physiological mechanisms that may have caused this polycythemia will not be discussed. At the present time there is no definite evidence of the way in which constant exposure to ether produces a polycythemia. The polycythemia may be due to increased formation of blood, or it may occur from a mobilization of reservoirs of red cells. From the hemoglobin estimations and from the histological appearance of the red cells in some of the male workers, it seems that slight anemia occurred in some of these individuals. It is known that anemia may exist concurrently with increased counts of the red cells as has been observed in cases of polycythemia vera.

In both the male and the female series of cases, the white cells were increased above normal, though not definitely in relation to the red counts. This increase may have been partially dependent upon the same physiological process that produced polycythemia, but was probably due, in part at least, to the direct effect of ether itself. The simple slight anemia which existed may also have been a factor, since in anemia there usually occurs a compensatory increase of white cells from the marrow. The very slight platelet increase may be similarly accounted for.

Summarizing briefly, it may be said that some individuals chronically exposed to ether fumes show polycythemia, increased white counts and, at times, evidence of slight anemia.

REPORT OF CASES OF PHOSPHORUS NECROSIS *

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

SINCE the prohibition of the use of yellow phosphorus in the manufacture of matches, dating from 1910, no cases of phosphorus necrosis have been reported in Great Britain from that source. A series of such as had occurred between 1900 and 1905 was published in the Annual Report of the Chief Inspector of Factories for 1905. In the years 1914–1918, however, phossy jaw underwent recrudescence. During this time eleven cases were reported from one factory in which the manufacture of phosphorus is carried on. They are given in detail in Table 1.

Until these cases, an apparent immunity, extending over many years, had been enjoyed. Although the number of individual workers brought into contact with phosphorus for one and another war purpose has been considerable, only one case has been reported in processes other than the manufacture. With this exception, all had worked for years in phosphorus processes. In the factory in question, examination of the dental condition by a surgeon and reference by him to a dentist of those whom he considered needed treatment had been relied on in past years, instead of examination by a dentist in the first instance, which would, in my opinion, have been the wiser course. After the first case (which proved fatal) in 1914, the firm engaged the services of a dentist with the intention, since carried out, of putting the teeth of those coming into contact with phosphorus into a sound condition, and linking up the work of the dentist with that of a consulting surgeon of the highest standing in case of need. The dentist attends two afternoons a week in the well-equipped dental surgery on the works and quarterly examination of all the workers has been arranged for. This examination has led to the detection of the cases of necrosis, the presence of which was shown after the removal of the decayed teeth. Dealing with these cases Mr. Thomas (Wallsall) reports as follows:

With three exceptions all the cases reported as suffering from phosphorus poisoning have been employed in connection with the condenser plant. The condenser plant is situated at the back of the furnaces, and the whole is contained in one large, lofty building. Men employed in the phosphorus process can be divided into two sections — furnace men and condenser men. It is noteworthy that among the furnace men no cases have been reported. These men do not handle phosphorus but are subject to the pentoxide fumes of burning phosphorus when any slight leak occurs on the furnace. Although in the same building as the condensers, the fumes from the condenser side do not appear to reach these men to any extent. This is probably due to the heated air rising from the furnace acting as a kind of screen. A much larger number of men are employed in handling phosphorus and phosphorus mud on the condenser side.

In emptying the condensers the crude phosphorus is syphoned off while in the molten state and run under water into cast iron moulds where it solidifies. After the phosphorus is drawn off, the residues, known as phosphorus mud, are also syphoned off and removed for further treatment.

During the syphoning and subsequent handling of the crude phosphorus and mud, fumes consisting of the lower oxides of phosphorus arise and similar fumes come from the mud which has splashed on to the wet floor. It was hardly practicable to remove these fumes by exhaust ventilation as there were so many points of origin. The efforts of the firm were concentrated on improving the condensers and the drainage of floors. Concrete was largely used in place of wood for the condensers and the floors between condensers were relaid. This improved the conditions, as splashes of phosphorus or mud could easily be swilled away. In addition, the sides of the building were opened up, so as to obtain better general ventilation. With improved condensers im-

* Reprinted, with amplification, from the Annual Report of the Chief Inspector of Factories and Workshops, Great Britain, for 1918. Received for publication Nov. 25, 1919.

TABLE 1. — REPORTED CASES OF PHOSPHORUS POISONING, 1915–1918

No.	Age	Sex	Precise Occupation to Which Poison was Attributed	Duration of Employment		Part Affected and Subsequent History	Severity	Duration of Illness	Report of Condition by Consulting Surgeon, January, 1919
				Factory	Phosphorus Process				
1	66	M	process man — on phosphorus condensers	many years	many years	Lower jaw. This man was pensioned off on Oct. 8, 1913. Died June 15, 1915.	fatal	Jan., 1914 to June 15, 1915	
2	44	M	process man — on phosphorus condensers	10 years	10 years	Left upper and right lower jaw. Operated on June 27, 1915. Certified as fit only for light work on Jan. 7, 1919.	severe	March 16, 1915 to present time	Both upper and lower jaws appear sound but there has been complaint recently of some discomfort on the left side of the superior maxilla. Directed to see the dentist again as to artificial teeth which he needs as his nutrition is suffering. He is getting thinner still and has lost weight, 2 stones altogether. Is fit only for light work.
3	47	M	process man — on phosphorus condensers	10 years	10 years	Right lower jaw. This man returned to work on Nov. 28, 1915 but was not employed amongst phosphorus. Now certified as fit for any work.	slight	April 23, 1915 to Nov. 28, 1915	Upper jaw is quite sound, the left side of lower jaw still rather sensitive; is not fit for artificial teeth for about six months, when he should see the dentist. May now do any work.
4	43	M	process man — on phosphorus condensers	6 years	6 years	Right lower jaw. This man returned to work Oct. 16, 1916 but was not employed amongst phosphorus.	moderate	Oct. 16, 1915 to Oct. 16, 1916	The jaw is sound but on the right side of the lower jaw the pressure of the dental plate is irritating and the plate cannot be used or some fresh trouble will be set up. He should see the dentist and if the present plate cannot be altered a new one should be provided. His nutrition is suffering and he is losing weight because of his inability to take ordinary food.
5	45	M	process man — on phosphorus condensers	23 years	23 years	Right upper jaw. This man returned to work Sept. 25, 1916 but was not employed amongst phosphorus. Now certified as fit for any work.	moderate	July 1, 1916 to Sept. 25, 1916	Both jaws are now sound and teeth are fixed without inflammation around them. May now do any work.
6	58	M	process man — on phosphorus condensers	many years	many years	Extensive necrosis in right upper jaw from tuberosity to incisor region — opening from mouth into antrum and nose; also small area in left upper premolar region. Now certified as fit for any work.	severe	June 5, 1917 to Sept. 4, 1918	Jaw is quite sound but the communication between mouth and antrum will be permanent. This is, however, protected by his upper denture. May now do any work.
7	23	M	soldering tins containing phosphorus	5 months	5 months	No necrosis. Phosphorus poisoning only: intense salivation.	severe		This man had been a sheet metal worker and was taken to solder up tins containing phosphorus owing to pressure of war work. He recovered and returned to his ordinary work.
8	26	M	process man — amorphous phosphorus	12 years	12 years	Extensive necrosis both sides of lower jaw from region of wisdom tooth to canine, right side, and premolar and molar region, left side. Returned to work Nov. 10, 1917 but was not employed amongst phosphorus. Now certified as fit for any work.	severe	June 2, 1917 to Nov. 10, 1917	The jaw is sound and the remaining teeth are sound but he needs dentures badly. May now do any work.
9	58	M	process man — on phosphorus condensers	$2\frac{1}{4}$ years	$2\frac{1}{4}$ years	Necrosis of lower jaw commencing about socket of lower left premolar, confined to external plate of alveolus and extending from region of left first molar to that of right premolars.	moderate	Dec. 3, 1917 to June 22, 1918	Is now quite sound with just a little numbness of the lower lip. The remaining teeth are sound but he is not wearing his artificial dentures which he should do. He may do any work.
10	28	M	process man — amorphous phosphorus	4 years	4 years	Left lower jaw from incisor region to first molar. Returned to work Aug. 18, 1918 but was not employed amongst phosphorus.	moderate	Nov. 1, 1917 to Aug. 18, 1918	
11	31	M	process man — on phosphorus condensers	4 years	4 years	Left side lower jaw. Is not fit yet to return to work.	severe	January, 1918 to present time	The jaw is healed but very sensitive still; some of the teeth are loose and the gum is rather inflamed. I should like this man to see the dentist. His general condition is unsatisfactory, and he is not yet fit for work.
12	47	M	process man — on phosphorus condensers	25 years	15 years	Right upper jaw region of first molar. Returned to work July 27, 1918 but was not employed amongst phosphorus.	severe	June, 1918 to July 27, 1918	

proved methods of working were introduced, so as to reduce the amount of handling and consequent exposure to air of the crude phosphorus and phosphorus mud. The amount of fume in the air became noticeably less, but there was still room for improvement. Further experiments were made which have proved that in the future it will be possible to draw off the phosphorus and phosphorus mud from the condensers in such a way that fumes can only escape at one or two points. These points of escape can easily be dealt with by means of exhaust ventilation.

Two cases of phosphorus poisoning occurred in the amorphous phosphorus department. In this department yellow phosphorus is converted into the amorphous or red variety. The amount of fume in this process is not great, and as the fumes are given off at definite points, they can be dealt with by means of exhaust ventilation. A satisfactory system of exhaust ventilation is now working.

THE ECONOMIC ASPECTS OF INDUSTRIAL MEDICINE *

CECIL K. DRINKER, M.D.
Associate Professor of Applied Physiology, Harvard Medical School
AND
KATHERINE R. DRINKER, M.D.
Managing Editor, Journal of Industrial Hygiene

As one first meets the conditions which govern the conduct of industrial medicine he is disturbed by them in direct proportion to the degree in which he has lived in the non-commercial aspects of medical life. With further experience the field discloses itself more fully, and it becomes possible to realize that there are two great reasons why medicine and industry do not meet as fairly as they should, without the relinquishment of anything by either side. The first of these reasons rests upon the fact that business knows nothing at all of the things medicine is now equipped to furnish; and the second, upon the fact that physicians know nothing whatsoever of the demands of productive business. There is a phrase which the employer uses very readily in relation to industrial medicine. He wants it "sold" to the employees. If his conception of selling means a fair return for both sides — and an honestly administered medical department in the hands of a well-trained and human physician can result in no other way — there can be no objection to the term; but if the medical department is designed to leave the profit all on one side, the physician may properly distrust the situation. Well-administered medical departments in industry rest, then, for their success, upon just the same principles of fair dealing which render successful arrangements as to wages, and if an even give and take does not exist, the maximum of success will not be secured.

A complexity of factors have apparently operated to place industrial medicine in the position in which it finds itself today. If we review the successive steps in the development of health legislation in England, it is not hard to realize — and this without making a brief for a working day of any standard length — that the procession of bills, which resulted in a steady betterment of working conditions from 1802 until 1878, have been economic life-savers for that country. The same truth applies to factory legislation in the United States. The permanent health of the working population can be and has been held fairly good through legislative enactment of varied type, and the regulations so established will continue to be of benefit as long as these nations endure.

There is a great difference, however, between the health conditions which are imposed through legislation and those which the employer and employee assume voluntarily. It is the latter which are creating interest today and which are the *raison d'être* of industrial medicine. We all recognize the eventual economic value of measures which regulate the work of women and children, and which forbid the existence of hazards such as every one knows have existed in the handling of lead, arsenic, and phosphorus. What we really want to know, however, is the extent to which group medicine pays in the factory, and this must not be in terms of intangible beliefs but it must be reduced to the coolest and surest of facts. The employer, as a rule, does not think of medicine as something which can be treated from a profit and loss point of view except in so far as the direct supervision of compensable

* Received for publication March 22, 1920.

cases is concerned. The idea that a well-trained industrial physician should be able to produce tangible results has never occurred to him. Medicine has always been a mysterious and unpleasant business which, so far as he has seen it intimately, must result in loss; and as a consequence he says, "Well, I suppose we've got to try it if every one else has started in," and thinks no more about the matter except to wish the costs of maintenance were not so great. Several reasons seem to operate to keep up this attitude on the part of the employer. One of these is the situation in which he very frequently places an intelligent and promising physician, making him but a cog in the machine of hiring and looking after men. The modern company, which at considerable expense secures a well-trained young chemist, realizes it gets but a poor return for this investment if the man in question has no chance to show his individual capacity and to bring to the company those infinitely valuable returns which imaginative work alone can secure. The chemist is placed in a laboratory with other chemists; and the fact that industry has fully realized the advantage of a sympathetic attitude toward their work is amply expressed in the daily achievements of the industrial chemists of this country.

If the industrial physician is a well-selected and well-trained man he must be given actual responsibility and opportunity to show in figures what his department can do. Such a result will never be attained without sympathetic executive oversight — the type of opportunity which the company is ready to accord to technical experts in other lines of work. Under such circumstances the physician should be able to show that his department justifies the outlay made for it, and if he fails in such a demonstration he has failed in his job. Frequently it happens that the medical department is given just such an opportunity as we have described, but nothing comes of it. We believe that a failure of this sort practically always arises from poor selection of the physician in charge of the department. A successful industrial physician must be a man who realizes that the vital function of industry is production, and that his task in the operations involved is to make production increase through safeguarding and improving the health of all those engaged in the work. In order to fulfill such a task, he requires a thorough knowledge of the best and most progressive practices in medicine, surgery, and hygiene, together with a sympathetic understanding of human beings. Such qualities are rarely combined. They certainly are not found in the unsuccessful general practitioner who takes a badly paid factory position as his last bulwark against disaster. Individuals of this type are doing much of the so-called industrial medicine in vogue today. The service they render, it may be fairly said, is just about commensurate with the pay they receive. From them the employer can expect nothing in the way of evidence indicating improved working capacity on the part of his force. The clumsy treatment of injuries and the administration of cathartics and adroitly exploited proprietary remedies represent quite fairly the limit of their capacity. The perspective of intelligently administered preventive medicine is one toward which they are hopelessly, permanently blind.

In order to prove to the employer and to the employee that industrial medicine is in reality an economic problem demanding the services of a well-paid and competent staff in whom every confidence may be placed, certain facts need to be made clear; and in some respects, as we shall indicate, these facts are not so convincing as they should and will be. The first of the facts is found in general evidence bearing upon the health of our working population. Recent experiences in the great war have been pro-

ductive of much material indicative of the working capacity of our young male population. Davenport and Love (1) have produced the first serviceable summary of the defects found in drafted men, and from their work we may gather data upon the omnipresence and importance of the health problem in industry. The total number of men involved in this study is about 2,500,000. In this total group 468 men were defective per 1000 examined; thus, almost half the men had some readily detectable physical or mental blemish. Davenport and Love summarize the defects found as shown in Table 1.

TABLE 1. — DISTRIBUTION OF DEFECTS IN DRAFTED MEN

	Per Cent.
Mechanical defects involving bones, joints, appendages, hands, and feet	39
Defects of the sense organs, eye, ear, etc.	12
Tuberculosis and venereal disease	11
Cardio-vascular diseases and defects	10
Defects of developmental and metabolic processes	10
Nervous and mental defects	6
Diseases of nose and throat	5
Diseases of skin and teeth	3
Diseases of respiratory organs other than tuberculosis	1
Other defects	3
Total	100

The first group of defects — mechanical defects involving bones, joints, appendages, hands, and feet — is of the most importance from the military point of view, but in some respects it is of equal importance in industrial medicine; thus, forty men in every 1000 had hernia. When grouped geographically Davenport and Love found the hernia incidence in the United States to be that shown in Table 2. In the light of this table, if the matter is viewed purely from the basis of just workmen's compensation, it is obvious, for example, that the New Jersey employer who does not have a medical department capable of making reliable examinations for hernia and of placing men so affected in properly supervised jobs, is running the risk of unjust demands for compensation. This statement becomes much more forcible when we realize that a far larger group with much wider age limits is employed by industry than is included in these draft statistics. It is probable that the addition of these individuals increases rather than decreases hernia incidence. It is equally true that the workmen in New Jersey, in view of the hernia incidence which apparently exists among them, neglect their own interests if they fail to take advantage of intelligent medical supervision.

TABLE 2. — THE GEOGRAPHICAL INCIDENCE OF HERNIA AND ENLARGED INGUINAL RINGS IN THE UNITED STATES

Number per Thousand			
21–30	31–40	41–50	51–116
South Dakota	Washington	Montana	Oregon
Nebraska	North Dakota	Idaho	California
Kansas	New Mexico	Utah	Nevada
Missouri	Oklahoma	Colorado	Wyoming
Arkansas	Texas	Wisconsin	W. Virginia
Louisiana	Minnesota	Michigan	New Jersey
Kentucky	Iowa	New Hampshire	Florida
Tennessee	Illinois	Vermont	
No. Carolina	Indiana	New York	
So. Carolina	Ohio	Pennsylvania	
Maryland	Mississippi	Delaware	
	Alabama		
	Georgia		
	Rhode Island		
	Maine		

Another fact of prime importance industrially is the matter of tuberculosis. Davenport and Love (1) discuss this as follows:

> The highest incidence of this disease [tuberculosis] is in the desert states of Arizona and New Mexico and the adjacent states of Colorado and California. The reason for this is that the described area includes so many young men who have gone there because they are already victims of active tuberculosis. . . . The next most infected territories are the two northernmost Pacific states, the New England states and New York, and the group of states immediately south of the Mason and Dixon line, including also the states of Missouri, Louisiana, Mississippi and Georgia. New England has long

been known as a region with a high rate of tuberculosis, a disease whose fires are fed by the large number of recent immigrants. The states of Virginia, North Carolina, and Kentucky contain numerous sanatoria for the tubercular. The high rate in the Gulf states is probably due to the presence in them of a large proportion of negroes, as this race, particularly the mulatto, is especially susceptible to tuberculosis. The smallest amount of tuberculosis is found in the Great Plains region and the northern part of the Rocky Mountain range. This is an area occupied largely by non-British stock, which comprises exceptionally vigorous people. Tuberculosis in the rural southern states tends to overweigh the rate of tuberculosis in the rural population of the country as a whole. But in general, the agricultural areas of the north show less tuberculosis than the urban districts.

Here again the employer and the employee are informed of dangers which it will be to their benefit to meet fairly, and which the efficient industrial physician can more advantageously combat than any other single medical agent. Clark (2) places this question in the proper light when he says, "Tuberculosis, when arrested, is no bar to employment in a modern factory. Of course the work must be selected and the patient watched, but many cases will do moderately hard work for years without breaking down or exhibiting signs of activity. Active tuberculosis has no place in the factory." The employer must accept tuberculosis as a constant expense in his business, and, as in every other situation, this expense is not to be counteracted by neglect. Only through the maintenance of a medical department can tuberculous individuals be kept continuously employable. Laborer and employer alike must benefit from the modern attitude toward the situation.

In conclusion, Davenport and Love bring out such facts as the following:

There are two great centers of defect — one is in the northeastern part of the United States, and the other in the western half, including especially the states on the Pacific coast and the two mountain states of Wyoming and Colorado. Of all states Rhode Island leads with a defect rate of 802 [per thousand]. This high defect rate, like that of the other New England states is largely controlled by flatfoot and hernia. In the case of Rhode Island, however, many minor defects find here the maximum or nearly the maximum ratio. Conditions in which Rhode Island stands first or second are: Alcoholism, obesity, neurosis, total for myopia and defective vision (cause not stated), hemorrhoids, bronchitis, deformities of appendages and trunk, atrophy of muscles of the extremities, underheight and underweight. The reason why Rhode Island stands at or near the top in many defects is largely because of the defective or non-resistant stock which has been drawn to this, the most urban of all states — that in which the population is most generally engaged in manufacturing. While one may not ascribe the defects to the occupation, it is probable that the relatively low-grade, ill-paid occupation has attracted a stock with inherent defects or susceptibility to disease.

Certainly both the workman and the employer have reason in Rhode Island to act positively and immediately in the organization of industrial medical departments. While we must realize that the draft figures which have been presented include many young men defective from a military point of view but vastly effective from the industrial point of view, we cannot get away from their insistence upon the necessity for health supervision in industry. A man with flatfoot is as completely disqualified for certain types of industrial work as he is for marching. A job which keeps him off his feet makes him as useful as his neighbor whose arches are normal. Medical supervision, which places men and women in work for which they are physically fitted, insures their future earning capacity and holds promise of increasing it, since failure from physical breakdown is lessened.

Let us turn now to further sources of evidence as to the health of our working population, drawing the material from industry itself. Emmet (3) has presented the most recent evidence available upon the number of days of disability experienced yearly by a group of 40,000 wage earners, practically

exclusively male. His figures list the disability experience of the Workmen's Sick and Death Benefit Fund of America. "The disability experience examined represents the average annual sickness for the five-year period ending December 31, 1916, and is, therefore, free from accidental variations, such as, for instance, those caused by the Spanish Influenza epidemic of last year." Nine days of disability per year has

TABLE 3. — AVERAGE ANNUAL NUMBER OF DISABILITY DAYS PER MEMBER AND DISABLED PERSON OF EACH CLASSIFIED FIVE-YEAR AGE GROUP

Age Group	Total No. of Disability Days	Total No. of Members Affected	Number of Disabled Persons	Average No. of Disability Days per	
				Member	Disabled Person
Under 20	2,108	406	127	5.2	16.6
20 to 24	34,296	7,168	1,778	4.8	19.3
25 to 29	76,619	15,267	3,574	5.0	21.4
30 to 34	106,162	21,886	4,862	4.9	21.8
35 to 39	155,209	27,496	6,197	5.6	25.0
40 to 44	196,206	30,746	7,104	6.4	27.6
45 to 49	206,860	31,579	7,150	6.6	28.9
50 to 54	189,850	25,484	6,044	7.4	31.4
55 to 59	146,777	16,229	4,168	9.0	35.2
60 to 64	80,459	6,689	1,859	12.0	43.3
65 to 69	25,361	1,843	557	13.8	45.5
70 and over	3,417	225	65	15.2	52.6
Total....	1,223,324	185,018	43,485	6.6	28.1

It will be noted that the number of disability days increases progressively toward the higher age groups.

been the allotment made for the United States — assuming that our disability experience is parallel to that of Europe. Contrary to this estimate, 6.6 days per year were lost by the group of workers in question. Table 3 summarizes Emmet's findings upon this group.

Forty-two industrial classes are represented among Emmet's 40,000 workers. Freight-handlers showed the largest average number of disability days, 9.7 a year. Miners came next with 9.1 days. Low in the list we find textile employees with less than the average number of disability days. No matter how one may view the figures, they portray a disastrous loss to the employer and to the employee. It is estimated that there are 25,000,000 industrial workers in the United States. If we multiply this figure by 6.6 we obtain 1,650,000,000 days of lost work in a year, a figure quite beyond our comprehension but if in error probably too small. It is unfortunately impossible to estimate the extent to which accidents and preventable disease, directly ascribable to industry and not to the home life of the individual, make up the 6.6 lost days. Nor can we, from these figures, obtain any reliable separation of accident disability and sickness disability. But the industrial life of the men making up this group represents at least one-third of the time involved in the study, and if but one-third of the disability of our working population is ascribable to their industrial existence, the economic loss involved should be a matter of concern for us all.

There are several routes of attack through which disability may be reduced. The actual prevention of accidents can accomplish much. With this work the medical department needs to keep in close touch, and that it does so is indicated in a recent study by Selby (4) who examined 118 establishments employing whole or part-time physicians. In twenty-eight of these the physicians accompany the safety inspectors on their regular rounds. Accident prevention has been largely an engineering and educational matter. There is evidence, however, that the overtired and subnormal worker operates with a careless disregard for the consequences to himself and to his fellows, which the healthy and normal worker does not readily display.

The extent to which disability from accidents may be reduced by a well-managed safety campaign is strikingly illustrated by Table 4 which gives the accident statistics

of the Commonwealth Steel Company for the years 1913 to 1918 (5). Instances of this type might be greatly multiplied but they are not directly related to the question of the economic value of the medical department in industry. The medical department contributes to the success they picture, but is by no means the sole source of it. The industrial physician does, however, enter the question of lost time from accidents upon the side of treatment. Can we present evidence that the period of disability is reduced through well-conducted treatment? The average industrial injury is slight, but owing to the desire of the workman to continue with his job, infection of untreated and unprotected injuries is practically certain to occur (6), and to infection we may ascribe much of the accident disability which causes economic loss both to the employee and to the employer. Clark (7), in 1917, records the fact that during the five years of operation of the medical department in the Norton Company of Worcester not a single case of sepsis has occurred. He remarks, "I do not feel that I can make the statement that we have never had a case of infection, for in several cases there has been a single drop of pus, or a moderate exudation from a wound. By sepsis I mean pain, heat, and redness accompanied by swelling. As we have been treating on an average of 241 accidents a month, it will be seen that the methods we use must be efficient." The crux of the treatment described rests in the fact that all injuries, however slight, reach the medical department within fifteen minutes, and before trouble has had a chance to start.

TABLE 4. — EFFECT OF SAFETY CAMPAIGN ON DISABILITY IN THE COMMONWEALTH STEEL COMPANY

Year	Deaths	Lost Time Cases	Compensation Cases	Compensation Received by Injured	Days Lost per Employee (Actual)
1913	2	800	330	$20,015	7.2
1914	1	414	168	8,138	4.2
1915	0	190	98	2,822	2.3
1916	0	769	223	7,638	2.6
1917	1	371	141	9,175	2.4
1918	0	124	57	4,391	0.6

Mock (8), reporting upon the same point in another large industry, says, "The number of infections following injuries has been reduced from 28.6 per cent. in 1912 to 7.57 per cent. in 1916. The time lost from infections in 1912 amounted to 1987 days, or an average of $2\frac{3}{5}$ days per case, while time loss from this cause in 1916 amounted to 816 days, or an average of $1\frac{1}{8}$ days. This was accomplished in spite of the fact that the working force had increased approximately one-fourth during the same period."

Another method of attack upon the economic loss reflected in the 6.6 days of disability which we have discussed, rests in the control of preventable illness by the medical department, and it is in this most important and useful phase of the work of the industrial physician that facts as to his efficacy are least available. Even if we make allowance for the fact that the task of demonstrating in figures that the medical department has reduced absenteeism from minor or major illness is a hard one, there is no excuse for the lack of existence of definite evidence upon the matter. We have begun to know what the standard causes of absenteeism from certain types of employment are, but our data are drawn from single industries and do not as yet represent the situation through industry as a whole. Thus Mock (8), in Table 5, presents a typical list of the diseases causing lost time for the Sears, Roebuck Company.

It should be possible to show that a well-managed medical department reduces the absenteeism arising from these causes, but as yet contributions showing that the industrial physician has accomplished this

end are not numerous. Lemon (9) speaks as follows in regard to the results attained by the medical department of the Milwaukee Electric Railway and Light Company:

In the year 1915, also, the average sickness per man per year was reduced from eight days in 1913 to a little more than four days per man per year.

We have in these combined results the summary of two factors: (1) a campaign of education, both within and without the company, for the prevention of accidents and (2) the result of a careful preliminary examination of employees, as well as a maintained high level of health incident to a very close supervision of the general health, by dividing the men employed into groups, in which they could be daily observed and in which the relief from the lesser ills which lead to greater could be had without delay.

Bardeen (10) has shown that the establishment of a medical department in the University of Wisconsin has produced results of a type which industrial physicians must also be gaining but which they have as yet failed to make public. He shows, for example, that naso-pharyngeal infections in which complications had developed decreased from 50 per cent. to 10 per cent., and that the average time lost from work decreased from eight and one-half to two and one-half days.

We have recently ascertained that in a large department store in Boston 40 per cent. of the absenteeism which can be classed as avoidable is due to illness. The physician undertaking such a task as this store presents should make it his business to show that gradually through proper attention to early cases and through proper measures as to health education and sanitation a great majority of the individuals formerly absent from work for minor causes are kept steadily at their tasks. It is true that a physician in a department store has not quite such a complete opportunity to control his patients as has the physician in charge of the students in a university, but his opportunity is much the same and his results ought to differ only in degree and not at all in kind.

The second way of determining the economic value of industrial medicine seems to us to be found in summarizing the opinions and actions of employers in regard to it. At the present time it is estimated that

TABLE 5. — DISEASES CAUSING TIME LOSS

	Number of Employees	Cases of Lost Time
Male	7,000	6,420
Female	5,000	15,244
Total	12,000	21,664

Minor Conditions	Female	Per Cent.	Male	Per Cent.
1. Headache	3778	24.0	1255	19.00
2. Dysmenorrhea	2935	18.9	...	...
3. Colds	2251	14.0	1313	20.40
4. "Grippe"	1354	08.0	956	14.80
5. Tonsillitis	974	06.0	883	13.70
6. Nausea	750	04.8	203	03.10
7. Other stomach conditions	403	02.6	331	05.00
8. Nervousness	355	02.3	42	00.60
9. Neuralgias, myalgias and pains in joints	188	01.3	123	01.90
10. Backache	153	01.0	111	01.80
11. Stiff neck	99	00.6	30	00.40
12. Eye conditions	172	01.2	56	00.87
13. Ear conditions	102	00.6	36	00.50
14. Fever	110	00.7	107	01.80
15. Diarrhea	130	00.8	74	01.10
16. Constipation	92	00.6	41	00.60
17. Fainting	132	00.8	13	00.20

Serious Conditions	Female	Per Cent.	Male	Per Cent.
18. Appendicitis	48	0.300	35	0.50
19. Bronchitis	27	0.180	45	0.60
20. Heart trouble	8	0.050	2	0.03
21. Kidney disease	4	0.020	4	0.06
22. Pleurisy	9	0.060	24	0.40
23. Pneumonia	2	0.010	12	0.20
24. Paralysis	1	0.007	1	0.01
25. Rheumatism	90	0.600	122	1.74
26. Anemic and generally run down	34	0.200	4	0.06
27. Acute contagious diseases	32	0.200	32	0.50
28. Typhoid fever	1	0.007	1	0.01
29. Tuberculosis	19	0.140	15	0.23
30. Miscellaneous	1281	8.400	505	7.80

there are 900 establishments in the United States, employing 1500 part-time and full-time physicians. This number increases constantly. There is no evidence that the employer, once a medical department is started, ever gives it up. He invariably enlarges its scope and improves the equipment, and this in spite of the fact that the cost of medical supervision is not light. Alexander (11), in 1916, found that the average cost of medical work per employee in ninety-nine establishments interrogated was $2.50. At the present time we know of two establishments where the cost is between $6 and $7 per employee, and there is certainly so disposition to curtail the service offered in either instance. It is probable that a figure of $5 per employee more nearly represents the average total cost of well-administered industrial medicine at the present time. There is no better evidence that industrial medicine pays than we find in this steady growth throughout the country. In it there is eloquent testimony of opinion of employers as to the value of the whole movement. Selby (4) has collected certain statements of employers giving their feeling upon this phase of the subject. He says:

Early in the study it was hoped that means for the valuation of industrial medical service could be found whereby definite limitations for expenditures could be justified, but such means could not be found. Employers are agreed that it has value, though they confess that the value for the most part is intangible and can not be expressed in terms of money. Failing in this, a different method was broached. "Why do you have a medical department?" responsible officials were asked.

"Purely for service," was the characteristic reply of one of the officers of the Ford Motor Co.

"We owe it to our men," said the superintendent of the Toledo Furnace Co.

"It is only human that we should take care of the men injured in our service," another answered, and he added with business acumen, "Constant expert medical service is insurance against big damages."

These and similar answers indicate that industry has a sense of its obligation toward the workers who become injured during employment. Another reason was brought out by other answers.

"It is a check on conditions that impair the health of our employees," testified the factory manager of the Willard Storage Battery Co. "It is just as necessary as a cost department, or any other nonproducing department," he continued.

"To safeguard the health of the workers in the belief that the healthy worker is more efficient." The sincerity of this answer was supported by the fact that a modern machine shop had been moved by this concern in order to provide quarters for a department of industrial relations, with divisions of health, safety, and labor."

"Health education will reduce absenteeism 50 per cent.," was the surprising assertion of the superintendent of the National Lamp Works, Youngstown, Ohio, a successful employer of female labor.

"Instruction to the new men as they pass through the dispensary upon employment has reduced accidents by 50 per cent. in four months," was the equally surprising asseveration of the physician of a rubber establishment.

"It keeps the men on the job," was a frequent answer.

From these replies and others of similar import it may be gathered that industry believes medical service is capable of removing or minimizing certain causes of lost time.

A slightly different phase is represented in the following answer, which came from the director of safety and medical service for the White Motor Co. "Our medical department," he said, "has no responsibility beyond repairing damage done at work, though the doctor takes care of injuries not contracted at work and sickness, to keep men on the job. Men able to do light work, but not their regular work, are given light work on regular pay. We have a man with a bad heart — on the job by constant care of the doctor. We have a man 60 years old who had had rheumatism since a child; he couldn't get life insurance. We keep him on the job through the doctor's help, in order that he can get a house paid for." This firm, it is of interest to mention, had an annual labor turnover of only 60 per cent. at a time (Feb. 28, 1918) when labor was exceedingly restless and turnovers of 200 to 300 per cent. were not unusual.

In striking contrast to this was the situation in a large and rapidly growing establishment in the Middle West. Without quoting directly, it seemed, according to the officer interviewed, that this company provided excellent working conditions, with good lighting, etc., but having sixteen plants it was difficult for them to organize a central, or in fact any,

medical department. However, the number of accidents was very small, how many he was not able to say. The working force was stable. They had men who had been with them nine years, since the company was organized. They stabilized their labor by treating employees right. Everyone had access to the management, and employees were kindly disposed toward them. Yes, they had some turnover. They hired 31,000 people in 1917. He could think of no reason except labor conditions and sickness. He closed the interview with a remark which was to the effect that his company was satisfied with the conditions. Point is given to these utterances by the fact that this company had a labor turnover for the year of 1917 that was somewhat over 400 per cent.

It does not necessarily follow that the absence of a modern medical service from the executive organization of this establishment caused the high turnover of labor, nor does it necessarily follow from the previous quotation that medical service is the panacea for labor turnover, but there is sufficient reason in this and the expressions of other employers to warrant the conclusion that medical service is regarded as one of several activities that have been found to be of use in removing certain unstabilizing influences from employment. In this connection the particular services which medicine is able to render are: (a) The moderation of the effects of accidental injury; (b) the prevention of some varieties of sickness and the alleviation of others; (c) the definition of the physical limitations of employees in order that they may not be overworked; and (d) the promotion of a feeling of security among the employees by the manifestation of interest in their personal welfare.

A manufacturer who has developed a medical department of unusual scope and activity goes further than this in his pronunciation for industrial medical service.

" It is the point of contact between the head and the men," he said. " It promotes a feeling of good will toward the management. It has saved us a strike. It increases earning capacity by making the men regular and dependable. Wages have increased 68 per cent. in seven years and the cost of material has gone up, as you know, but our cost of production none."

Medical service according to him is able not only to assist in the stabilization of labor, but to increase its productivity as well. Others contributed to this opinion.

" Why do we have a dispensary ? " asked one, and he answered, " It pays."

" It's good business," said another, and he spoke for many.

A slightly different aspect is represented in the acknowledgment of the man who considers expert medical service to be a source of economy. " It saves us money," he replied, and confessed further, " It prevents litigation and keeps men on the job."

" It reduces our insurance cost," admitted another, in similar vein.

Expert medical service, according to these expressions, has proven to be good business, which indicates that it is profitable to industry, and an economical means of providing for the care of injured employees. More gratifying to the medical profession is the following reply:

" These measures (the activities of a proficient medical department) result in increased regularity and efficiency at work, reducing absence and alleviating pain, discomfort, and anxiety. In the minds of employees is created a sense of security, of confidence that they are working under the best possible conditions, that their physical welfare is being cared for, and that in accident or sickness proper attention will be provided. A healthier and more contented body of workers, with a higher industrial earning power, is the result."

Some employers were forced to provide medical service by reason of the locations of their establishments, others did so because it was " usual to such industries," and one was frank enough to concede that it was the insistence of his doctor that caused him to put in a medical department.

It appears from these expressions that industrial medical service is not a gift to labor, nor a charity, but purely a function of good business. The reasons which induce employers to provide their workers with medical service may be summarized as follows:

1. It is an acknowledgment of their obligation toward the workers who sustain injuries during employment and an economical means of procuring expert attention for them.

2. It is deemed capable of removing or minimizing certain causes of lost time.

3. It is one of several activities that have been found to be of use in removing certain unstabilizing influences from employment, and as such can be expected to assist in holding down the labor turnover.

4. It enables the workers to produce more.

5. It prevents litigation and reduces compensation expense.

6. It contributes to a sense of security among employees and promotes a feeling of good will toward the management.

7. Conditions make it imperative in isolated industrial establishments.

The third and last source of evidence as to the economic value of industrial medi-

cine is found in the attitude of the employee. The medical department cannot perform a one-sided function, and unless it is honestly of as much service to the employees as it is to the employer it must fail.

The attitude of labor is not hard to understand. Andrews (12), in 1916, wrote twenty leaders in labor organizations asking their opinion as to physical examination of entering employees. His replies without exception oppose it. Two of them are as follows, the first from an officer of the Iron Moulders' Union, the second from a California labor editor:

(1) In a general way I am most emphatically opposed to any physical examination of employees. Physical examination conducted under private auspices, that is, by physicians in the employer's hire, should not be tolerated for a moment.

(2) There seems to be an epidemic on among employers for the physical examination of employees. . . . These examinations are conducted more in the interests of profits than for the improvement of health conditions, and labor must insist that there shall be a well-defined limit to them until such time as ample provision shall have been made for the safeguarding of the health of the worker and caring for those excluded from the privilege of working because of the examinations.

The recent demand that physical examinations be abolished, made by the steel strikers, reflects the same feeling. Labor thus seems to distrust and deprecate one of the fundamental requirements of industrial medicine. But a view more consistent with progress (13) is found in the following quotation from the Committee on Welfare Work, of the Committee on Labor (Samuel Gompers, Chairman) of the Advisory Commission of the Council of National Defense, which was prompted to action in this regard by the need for greater consideration of the health of workers to maintain maximum production on war work.

It is the sense of this conference that the physical examination of workers is primarily a measure of health conservation and also essential to maximum production — a war necessity.

That the purpose of a medical examination is not to eliminate the worker from industrial service but to adapt him to the work he is physically fitted for.

Therefore be it Resolved, In view of the publicly announced policy of the government centralizing the recruiting of labor in the United States Employment Service, that this conference recommend that the medical examination of the workers be one of the functions of the government labor recruiting agency.

It further recommends the establishment of a central examination board, composed of representatives of the workers, employers, and the government.

That this board issue examination cards indicating the health of the workers and classify according to physical fitness.

Such a system of centralizing physical examination of workers does not prevent employers from maintaining their own system of physical examinations and follow-up methods for the purpose of conserving the health of their workers.

Mr. William Green, secretary-treasurer of the United Mine Workers of America, at the meeting of the International Association of Industrial Accident Boards and Commissions held in Washington in 1916, remarked:

In considering physical examination and medical supervision of employees it is all important that the primary purpose of said physical examination and medical supervision should be understood. If the primary purpose of physical examination is to promote the general welfare, to ascertain for what position the examined employee is best fitted, if it is for the purpose of building up the broken body or the diseased individual, then it certainly must be commended, because that is a praiseworthy purpose. If medical supervision is for the purpose of maintaining the physical standard of the employee at the highest possible point; if it is for the purpose of keeping him well and strong, of guarding and watching his health, then that is praiseworthy, and I know that the laboring people generally will have no objection to such physical examination and such medical supervision. But if the primary purpose of physical examination is to exclude the physically unfit, then the wage-earners are unalterably opposed to such physical examination. It would be inhuman and uncivilized to adopt a policy of ascertaining who the physically unfit were for the mere purpose of closing the door of opportunity to them. Even the savage would not do that, and surely in this twentieth-century, highly developed civilization we are not attempting to foster

a policy that is going to throw upon the scrap heap as helpless the physically unfit. They must be taken care of in some manner.

. . . Labor has no objection to physical examination or to medical supervision when the purpose of it all is praiseworthy, as I have stated, but they will oppose a policy that has for its purpose the exclusion of him who may be diseased or physically deformed.

We have not as yet discussed the saving to the employer which results from rejecting employees who are physically unfit. Mock (8, 14) covers this aspect of the economic utility of industrial medicine in considerable detail, and gives statistics which he collected from ten large industries having excellent medical staffs and basing their rejections upon reliable standards. Mock's figures are given in Table 6.

TABLE 6. — APPLICANTS EXAMINED AND APPLICANTS REJECTED BY THE MEDICAL STAFFS OF TEN INDUSTRIES

Item	Number	Per Cent.
Total number of applicants examined in one year	118,900	. . .
Total number employed having disabilities that did not interfere with selected work	41,158	34.7
Total number rejected for work because of disabilities	11,433	9.7
Total number having no disabilities of any moment	66,309	55.6
Total number of regular employees in those ten industries	102,400	. . .

It has been estimated that $35 represents the average cost of hiring and training a worker. Multiplying this figure by 11,433, Mock's number of rejected cases, there is a saving of $400,155 in labor turnover. It is just this saving which the employees distrust. They recognize that the mentally deficient and the man with active tuberculosis cannot be hired, but they fear that with the elimination of such as these go others upon less just grounds. The employer who possesses a thoroughly effective medical department will be able to show that his rejections for physical reasons are extremely few. Clark (15), speaking from his experience in the Norton Company, where the restrictive list of defects is rather severe because of the heavy nature of the work, finds that 3.5 per cent. of those applying for work are rejected on physical grounds. Howe (16) regards 10 per cent. as a normal figure for rejections and this coincides with the 9.7 per cent. found in Table 6. One cannot but feel that this figure is susceptible of reduction and that in any case the largest financial return from the medical department should not rest upon it. The employer must make his profit by fitting the physical conditions of the worker to his task, and to this principle labor has published no objection and through action has given every commendation.

Price (17) has given a brief account of the organization and methods of medical supervision in the garment trades in New York. Beginning in 1912 and until January 1, 1919, 27,640 medical examinations were made of garment workers in the medical clinic of the Joint Board of Sanitary Control. This board, in accordance with the agreement reached in 1910 following the strike in the cloak and skirt industry, consists of representatives from the public, from the employers, and from the garment trades union. It is most interesting that beginning in 1917 the clinic has examined every applicant for membership to the union, the unions having passed a law not to accept any candidates without a preliminary medical examination in the clinic.

All the work in the clinic is paid for by the labor organizations; the members themselves pay nothing except that those members who are not in good standing are charged a small fee for medical examination and treatment. An important extension of the work of the clinic is the nose, throat, eye and ear clinics, which are on a pay and co-operative basis. In other words, these clinics do not give gratuitous service but charge a nominal rate of $1 for eye, nose, throat, and ear examinations, by specialists. These special clinics are conducted at special times.

Another important extension of the activities of the clinic is the dental clinic. This clinic is a unique

establishment, in the fact that it is probably the first industrial co-operative, self-paying, dental clinic established, conducted, and managed by the workers themselves. The 27,000 examinations made in the medical clinic have clearly shown that a great many of the workers are suffering from defective teeth, and have likewise shown that a large number of these defects were directly contributory to various diseased conditions among these workers. Furthermore, it has been shown that the ordinary dental work which has been perpetrated upon the poor workers on the east side in New York City not only does not do them any good but does them real harm. Many of their dental defects are simply hidden and obscured by the gold crowns and bridges which are so lucrative to the dentists and so harmful to the patients.

The dental clinic is established to do thoroughly honest work in dentistry at a reasonable cost. The clinic employs a competent medical dentist who is doing good work and whose purpose is not so much curative as prophylactic. Educational work in prophylaxis is carried on all the time and is the main purpose of the clinic. All work is done in the clinic, which at present employs two full-time and two part-time dentists. During the year 1918, the dental clinic treated 7,465 patients, and has had an income of $12,576.73. It has practically paid for itself, although it had a slight deficit of $292. The charges to patients are based upon cost, approximately $2.50 being charged for an hour's work. Both the medical and dental clinics are very popular among the workers, and have proved successful in every respect.

The main significance of these clinics lies, of course, in the fact that they are conducted, financed, and managed by the workers themselves, for their own benefit.

Labor thus gives evidence of its appreciation of exactly the type of medical supervision which the employer has found worth while. What it objects to is the possibility that, if managed by the employer alone, medicine contains discriminative possibilities which may result in decided unfairness. The employer may rest assured that industrial medicine carried on by well-trained, forward-looking physicians cannot produce its greatest benefits for him unless it operates upon a completely impartial basis. It must not be "welfare work." It must not be a "finger wrapping" and compensation adjustment business. Medicine is something in which it is peculiarly easy to have faith, and the employer must have faith that the medical department in his factory is supplying him with healthy and efficient workmen through whom production will increase. The employee must have faith that the medical department exists for his interest to make him fit and to keep him fit, to see that his working life is prolonged and his earning capacity increased. It is the duty of the industrial physician to remove these faiths, translating them into facts through clear demonstrations of his part in advancing the productiveness and well-being of the whole organization.

BIBLIOGRAPHY

1. Davenport, C. B., and Love, A. G.: Defects Found in Drafted Men. The Scientific Monthly, 1920, **10**, 5 and 125.
2. Clark, W. I., Jr.: The Adjustment of Physical Defectives to Employment. Boston Med. and Surg. Jour., 1917, **177**, 578.
3. Emmet, B.: Disability by Age and Occupation. Modern Medicine, 1919, **1**, 379.
4. Selby, C. D.: Studies of the Medical and Surgical Care of Industrial Workers. U. S. Public Health Service, Public Health Bulletin No. 99, Washington, D. C., 1919.
5. Payne, E. G.: Education in Accident Prevention. Chicago: Lyons and Carnahan, 1919, p. 11.
6. Ohio Industrial Commission. Department of Investigation and Statistics. Report 29. Infections Following Industrial Accidents in Ohio. Columbus, March 1, 1917.
7. Clark, W. I., Jr.: Medical Supervision of Factory Employees: Result of Five Years' Experience. Jour. Am. Med. Assn., 1917, **68**, 5.
8. Mock, H. E.: Industrial Medicine and Surgery. Philadelphia, W. B. Saunders Company, 1919. Treatment of Hand Infections from an Economic Viewpoint. Surgery, Gynecology and Obstetrics, 1915, **20**, 481–488.
9. Lemon, C. H.: Medical Supervision of Street Railway Employees. Jour. Am. Med. Assn., 1917, **68**, 95.

10. Bardeen, C. R.: Medical Supervision of Students at Wisconsin. Modern Medicine, 1919, **1**, 468.
11. Alexander, M.: Cost of Health Supervision in Industry. Modern Hospital, 1919, **12**, 376.
12. Andrews, J. B.: Physical Examination of Employees. Am. Jour. Public Health, 1916, **6**, 825.
13. Selection and Placement of the Worker. Handbook on Employment Management in the Shipyard. Bulletin III, 1919. United States Shipping Board Emergency Fleet Corporation, Philadelphia, 1919.
14. Mock, H. E.: Industrial Medicine and Surgery — A Résumé of Its Development, Scope and Benefits. Jour. Industrial Hygiene, 1919, **1**, 251.
15. Clark, W. I., Jr.: Physical Examination and Medical Supervision of Factory Employees. Boston Med. and Surg. Jour., 1917, **176**, 239.
16. Howe, G. L.: Why a Factory Doctor's Salary Costs Less than Nothing. Factory, 1920, **24**, 618.
17. Price, G. M.: Industrial Medical and Dental Clinics in the Women's Garment Trades. Modern Medicine, 1919, **1**, 47.

MEDICAL SUPERVISION IN FACTORIES *

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

[This lecture was written with the needs of Great Britain in mind and without intimate knowledge of the development industrial medicine and surgery have undergone in the larger factories in the United States as described in Dr. Mock's monumental book. The conditions, and consequently the needs, in the two countries are not comparable and each will have to work out its own salvation independently of the other. The most notable difference between Great Britain and the United States as regards medical treatment of workers is the absence in the latter of a system of national insurance against sickness. The benefit of the National Health Insurance Act, to my mind, is that when any worker is found suffering from a condition requiring medical treatment, one can recommend the patient to go to his or her panel doctor and, knowing the standard of medical education in this country, feel that in the great majority of cases of illness reasonable treatment is obtained. While "reasonable" treatment is secured, it is not always the best obtainable, seeing that the National Health Insurance Act has not linked up treatment by the panel doctor with treatment in particular cases by specialists; nor is there as yet any return flow from the panel into the factory to reduce sickness there and thus reduce the claims which will otherwise ultimately be made. Legislation on both these points may confidently be expected before long under the newly constituted Ministry of Health.

The advantage I see in the direction industrial medicine has taken in America in the larger works is that the stimulus for its proper development and working comes from within the factory and is not imposed by the state from without; and, in a country where individualism counts for so much, it may be best. In Great Britain, however, it is doubtful whether workmen, organized as they are, would submit to a system which places them under medical supervision entirely under the control of the employer. I think it right that the employer should know the physical condition of those he employs, but this, in Great Britain, could best be secured by a part-time State Medical Service. One of the recommendations made at the International Labor Conference held at Washington in November last was that each member "which has not already done so should establish as soon as possible, not only a system of efficient factory inspection, but also in addition thereto a government service especially charged with the duty of safeguarding the health of the workers, which will keep in touch with the International Labor Office.]

NO book exists in the English language on the work of the factory surgeon.† This is remarkable, seeing that for a number of years some 2000 factory surgeons have been in existence. Every district in England must have its certifying factory surgeon, just as it must have its medical officer of health or surveyor. In Germany, on the other hand, there is not a single certifying surgeon, and beyond a few works surgeons in large chemical and other factories, and a few surgeons appointed to make periodical examinations in dangerous trades, only one or two medical inspectors of factories. But a book has been written there by Dr. Theodor Sommerfeld, called *The Factory Surgeon*. The book was published in 1906, with the object of assisting a movement for making medical knowledge an essential feature of factory administration in that country. Sommerfeld believes that a factory surgeon should be a medical man, well grounded in the practice of medicine, possessing also a knowledge of the special senses so as to make it unnecessary to call in a specialist immediately to determine, for instance, the effect of an injury to the eye, to the ear, or to the nervous system; he should, moreover, have special knowledge of public health work in its relation to factory premises, and have undergone a course of instruction at a university or technical

* Cutter Lecture in Preventive Medicine and Hygiene, delivered at the Harvard Medical School, Boston, Mass., Dec. 10, 1919. Received for publication Dec. 10, 1919.

† I retract this statement now and pay homage to *Industrial Medicine and Surgery*, by Dr. H. E. Mock, published since this lecture was delivered. — *T. M. L. April 27, 1920.*

school, in which industrial hygiene in its social, political, chemical, and physiological aspects had found a place. Such special knowledge cannot naturally be expected in the preparatory studies which a student of medicine must acquire, but it does fit in with postgraduate courses of study and particularly with those required for the diploma of public health.

The present duties of certifying surgeons, as laid down in the Factory Act and the Instructions of the Secretary of State, are briefly:

1. The granting or refusing of certificates of fitness within seven days of employment, for children and young persons under 16 years of age, or the qualifying of these certificates on the conditions and nature of the employment to which they may be put.
2. The reporting of cases of specified industrial diseases and poisonings.
3. Periodic examination of workpeople in certain dangerous trades under regulations or special rules.
4. Examination of those suffering from certain industrial diseases scheduled in Section 8 of the Workmen's Compensation Act, 1906, and the granting to them of certificates to enable them to claim compensation.

Of these duties, the one which is most before the certifying surgeon is the first, and it is important to bear in mind the limited character of the certificate which the law allows him to give, as misconception on the subject is great. The surgeon is merely asked to certify, after being satisfied as to the age of the child by the production of a certificate of birth or other sufficient evidence, that the child or young person has been personally examined by him, and is not incapacitated by disease or bodily infirmity from working daily for the time allowed by law. Observe the limited nature of the requirement without any words such as are found in the New York State labor law as to the child or young person's being "in sound health," which would make all the difference and enable a "hold" up to be effected until all remediable defects were remedied. If the child is able to walk up to the surgeon, showing that he is not halt or maimed or blind, if he can answer the surgeon's questions, showing that he is not deaf or dumb, and if the surgeon sees that the child is not obviously suffering from infectious or contagious disease, including pediculosis, he has difficulty in refusing a certificate.

Naturally, most surgeons do much more than this, and the following points are specified to be borne in mind when making an examination:

1. Auscultation of the heart, and presence or absence of anemia.
2. State of the glands in the neck.
3. Condition as regards tonsils and adenoids.
4. Condition of the teeth.
5. Infectious or contagious diseases including pediculi capitis.
6. Physical development.
7. Mental condition.
8. Hearing.
9. Sight.

There is a remarkable difference between a certifying surgeon's examination and that of a school medical officer. The object of the latter is to search out and make good the physical defects of the child while he is at school, so as to fit him for his work in the world. On the other hand, when the young person is presented or presents himself for a certificate of fitness, he is already starting on his life's work and is in the position of a bread winner, when many considerations may suggest themselves which make it undesirable to refuse a certificate. The wages he will earn may enable him to obtain better food, and so improve his general health. Again, if he be refused he may go round the corner to a workshop where the conditions may be much worse than in a factory, but there no certificate of fitness is required before employment.

I attach very little importance to the remarks of the lay person, whether manager, foreman, welfare supervisor, or factory inspector, who says that "the doctor just

looks at the child and signs his name," and that in consequence the examination is "a farce." These expressions of opinion fail to recognize how much is conveyed to the trained mind of the medical man from a superficial examination. Just as an agriculturist, travelling by train, is able to form a much better judgment of the productivity of the land over which he travels than an untrained person, so a physician from a brief inspection can make a much better judgment than a layman of the general physical condition of an individual. Still, the saying "Nothing for nothing, and very little for sixpence" is true, sixpence being the fee paid for a single examination; the minimum fee, including the examination of five persons, being 2/6.

The inherent defect, however, of the system has been a lack of any power to follow up and re-examine; this has interfered more than anything else with the usefulness of the examination. If there is a marked physical or mental defect, the candidate must be rejected. The surgeon has no power of saying "Let me see you in a month or two months' time." When once a young person has been refused, it is nobody's duty to see that the faulty conditions are remedied. The examination must be at the factory, unless fewer than five children or young persons are employed. Here, although there is opportunity of seeing the work to be done, facilities for examining are few.

Notwithstanding these objections I maintain that the value of the examinations has been very great. In the United Kingdom in 1913 the number examined was 529,491, and the number rejected 15,309, nearly 3 per cent. Of the 15,309 rejections, 10,797 (2 per cent.) were on medical grounds. These included: imperfect growth or impaired use of limbs, 564; defective sight or disease of eyes, 1,350; deafness, 290; mental defect, 89; disease of heart or lungs, 531; anemia or debility, 536; infection, 758; disease of skin, 468; want of cleanliness, 4,675; other medical reasons, 1,536. The remaining 4,512 rejections were: on account of age, 375; want of evidence of age, 3,460; other non-medical reasons, 677.

The surgeon has a useful power, given him in the 1901 act, of qualifying his certificate by conditions as to the work upon which the child or young person is fit to be employed. Indeed, certain associated conditions of infirmity and employment suggest themselves at once as undesirable, such as: (1) employment near machinery by workers with defective eyesight (monocular vision, errors of refraction), total deafness, mental defects and epilepsy; (2) the carrying of heavy weights by those suffering from anemia, and imperfect growth, lateral curvature, and heart disease; (3) work with poisonous substances by those affected with mental defect, or displaying obvious lack of cleanliness; (4) employment in processes involving dust by workers with weak chests.

Some certifying surgeons indeed have, in various industries, particularized the processes in detail, from the point of view of fitness for employment. But still the limiting conditions must refer to the work, and cannot be made to have personal application. Thus, there is no statutory power to attach the personal condition to "receive medical attention," or "wear suitable glasses," although the surgeon can, and naturally does, advise it. In a case of defective vision the surgeon can reject a candidate, saying that if the young person will present himself again with suitable glasses he will be passed, but the surgeon cannot pass the applicant on his promise to wear suitable glasses because he has no power of following the matter up. Any condition he can apply must refer to the nature of the work the young person of defective sight can engage on, such as, "not to work near machinery."

But listen to what one of the certifying surgeons in the East End of London does and has done, to my knowledge, for thirty years and more under these limited powers.

When I examine young persons *at the factory* I see them with the signs of their employment upon them, and as the occupier or his manager is usually present I can make enquiries and give certain instructions; for instance, in dusty trades I advise caps and overalls. I forbid girls who bite their nails to strip or handle moist tobacco, to handle lead, bronze powder, paint, poisonous drugs, or stains containing bichromate of potash. I forbid girls with loose hair to work on power machinery and I similarly restrict the employment of deaf persons. I forbid girls with obvious errors of refraction to do fine work without proper correcting glasses. I forbid girls with paralysed or deformed limbs to operate treadle machines. I forbid young persons of defective physique, healed tubercular joints or twisted spines to carry weights and restrict them to very light occupations. I also advise young persons suffering from non-infectious skin affections, septic mouths, etc. to submit themselves to hospital treatment and I suggest that the occupier shall be allowed to see the O. P. card so as to make sure that instructions have been obeyed. Some of my requirements are covered by the conditions affixed to the certificate of fitness, but this is in many cases insufficient inasmuch as I frequently recommend things not legally enforceable but I find that the occupier is almost invariably willing to follow my advice when its necessity is pointed out to him.

On the other hand, I find that young persons (particularly girls) attend for examination at my office *away from the factory* in their outdoor clothes and with no precise indication of their actual employment, of which indeed they are often ignorant. No responsible person attends with them to whom instructions can be given, moreover, many of the General Registers are badly kept and essential details are omitted so that considerable difficulties are unavoidable.

Young persons are now kept at school until the end of the term in which they attain the age of fourteen years; within the last week I have had a large number of such young persons to examine and I have been surprised at the number I found in a more or less verminous condition, which must have existed without detection during their school life. I think the school Doctor looks upon himself as rather above the school Nurse; anyway, I am certain that most school Medical Officers are utterly ignorant of trade processes and requirements, and unfitted to certify for Factory Employment.

The question arises: Why has there been this extraordinary limitation of the medical supervision of children and young persons in factories? To explain it we have to go back to 1833, when a certificate was first required from a surgeon or physician in the act to regulate the labor of children and young persons in the mills and factories of the United Kingdom. There were no birth certificates in those days, and the public conscience had been aroused by the excessively long hours worked by young children of 8 or 9 years of age. That act limited the age of employment in factories to 9 years and, in order that there might be some check on the employment of children less than 9, a certificate was required stating that each child had been personally examined or inspected, and that he or she was of the ordinary strength and appearance of a child of at least 9 years of age. So that it is clear no physical examination was in mind beyond that necessary to gauge the age. Later, in the act of 1844, it was still a question of age that was prominent, although by that time birth certification had been introduced. Certifying surgeons were required to make their examinations in the factory and not at their own houses. The fees were then fixed for this attestation of age but, in addition to the statement as to ordinary strength and appearance, the words " is not incapacitated by disease or bodily infirmity from working daily in the above named factory for the time allowed by this act " were further introduced.

Perhaps the most valuable work the surgeon has been able to effect has been the inculcation of the elementary principle of hygiene, i. e., cleanliness, by his steady rejection of uncleanliness of the head, which seems to baffle the efforts of school medical officers and teachers in elementary schools. We should not despise the day of small things.

The other duties of the certifying surgeon—namely, reporting on industrial disease, periodic examinations, and examinations under the workmen's compensation act—have been added by later acts and no one questions their value. Indeed, study of the reports on lead poisoning has been invaluable as showing the industries in which it is most frequent, the precise occupation in these industries where the workers run the greatest risk, and the fact that the cause of lead poisoning is, above all, the prevalence of dust and fumes. These duties, however, need not detain us now as there is no question of discontinuing them in future.

The time is ripe, however, for the reorganization of medical supervision in factories on wider lines than those which have been pursued hitherto. Undoubtedly, not less but more medical supervision is needed. As I conceive it, the future organization of medical supervision presupposes a medical inspector of factories in each division, who would act as liaison officer between headquarters, the divisional staff, and the factory surgeon.

The main duty of the factory surgeon should be, in my opinion, to bring his clinical knowledge to bear on the prevention of illness and injury from occupation, and to effect a cure, so far as possible, without absence from work. Too much, I think, has been expected from the certifying surgeon in the past, when asked to report on accidents caused by machinery. Many medical men are not interested in machinery, they have no technical knowledge of machinery, they have no technical training in the fencing of machinery. They were asked to report on a solitary accident and, when their report was made, all further concern on their part ceased. They ought not to be expected to be authorities on machinery accidents, or even on factory ventilation which is an expert matter and requires special training, nor on lighting, nor on heating. What they can do is to examine the chest, to examine the heart, and to say whether the person is physically fit for the work proposed for him. Only, in my opinion, when this is recognized, will the proper function of the medical man in the factory be performed. In order to bring this clinical knowledge to bear a surgeon should periodically visit the factory — how often, would depend on the size of the factory and the nature of the processes carried on. In works employing over 1,500 workers, his visits would probably take place at least daily, and in smaller factories at less frequent intervals but rarely less than once a month. If the occupier, as is likely in large factories, appoints a medical man approved by the medical inspector, arrangements might be made for attendance at least thrice a week for, say, two hours, and such provision should absolve the factory surgeon from any visit except for special inquiries.

The duties of the factory surgeon should be:

1. Initial detailed medical examination of all applicants for work, attaching, where necessary, conditional certificates either on personal grounds or as to the nature of the work on which the person is to be employed.

2. Re-examination of such persons as he considers need it, and power of inquiry, to see if previous conditional certificates have been observed.

3. Periodic medical examination, under Regulations and Special Rules, of workers in specified dangerous processes and in other processes, if so requested in writing by the medical inspector.

4. Periodic medical examination of the tuberculous, and of others (e. g., those with heart disease, disabled soldiers, etc.) affected with illness which, if not watched, might prove incapacitating, with power to specify the nature of the work upon which they may be employed.

5. Examination of cases referred to him by the welfare supervisor, and especially to advise in such cases as outbreaks of occupational dermatitis and the like, for which treatment could be prescribed.

6. Investigation of cases of poisoning, etc., notified under Section 73, 1901, and of cases prescribed under the Police Factories (Miscellaneous Provisions) Act, 1916.

7. Periodic inspection of the first-aid and ambulance equipment.

8. The making of such inquiries as may be required from time to time by the Secretary of State.

9. Performance of the duties required from the certifying surgeon by the Workmen's Compensation Act, with regard to certain industrial diseases.

Each one of these points deserves a lecture to itself, but here I can do no more than merely state them.

These duties do not include one examination specifically ordered, to comply with Section 64 of the Factory and Workshop Act, 1901, i. e., examination within seven days of employment. The young person will have been medically examined at school, and provision should be made to bring the result of the school medical officer's examination to the knowledge of the factory surgeon at his next periodic visit to the factory. Such a school certificate would take the place of the birth certificate, and might be of such a character that in country districts with few and unimportant factories the appointment of a factory surgeon would be altogether unnecessary. I am convinced, however, that in all industrial districts, a factory surgeon is essential, and that he should be independent of the local education authority.

What I have in mind in the factory is preventive medicine from the clinical side, that is, reduction of illness and inefficiency, and of their causes by medical or surgical supervision and treatment. The most suitable person, in my opinion, to give this treatment is the type of person now appointed as certifying surgeon — a man in general practice or a consultant, who knows the home conditions and treats the workers in his own surgery and is alive to advances in medical and surgical knowledge.

My objection to the whole-time medical officer of health (or an assistant medical officer of health, combining the duties of school medical officer, as would necessarily have to be done, in view of the amount of work) is that he is not in touch with clinical medicine, often does not live in the district, is not brought into intimate contact with the workers as patients in their own homes, is usually a man freshly qualified, intending only to remain until he can get a more remunerative post, and appointed by and subject to either the public health or education committee. Nothing in this conflicts in the least with the useful work the school medical officer would do in examining, *in continuation schools*, young persons up to the age of 18, with a view to rectifying physical defects.

I should like to see the works surgeon a unit connecting the Factory Department with the National Health Insurance Commission, so as to diminish the amount of the claims on the insurance funds by preventive clinical supervision in the factory. I do not see how, under this scheme, the factory surgeon can possibly be paid for his duties in the way he is now, i. e., by small fees from the occupier for each service rendered, after the reception of which all his responsibility ceases. Such a procedure cuts at the root of all following up. I should prefer to see the factory surgeon a part-time state salaried officer, on the lines suggested in the Cavendish lecture on "The Future of the Medical Profession" by Sir Bertrand Dawson in the *British Medical Journal* of July 13, 1919. I am glad to see how favorably such part-time service, properly controlled, is regarded in the United States. Seeing that the whole scheme is drawn up in the interests of industry, it would be right that the expense in carrying it out should ultimately be a tax on industry. Occupiers might be expected to pay an annual sum, dependent on the size of the factory, out of which the salary of the factory surgeon would be paid.

THE PHARMACOLOGY OF HEAVY METALS*

WILLIAM SALANT, M.D.

THE behavior of heavy metals has long been the subject of inquiry by pharmacologists and toxicologists—inquiry resulting in the growth of an extensive literature on the subject. Indeed, a bibliography of the action of heavy metals would fill many pages including such investigations as their manner of absorption, their fate in the body, their effects on metabolism and their influence on different organs. There is, nevertheless, a striking paucity of data concerning the action of some of the heavy metals, while the behavior of others in the body is scarcely known. This is true notwithstanding the fact that many cases of poisoning have occurred as a result of presence of these metals in food products and notwithstanding the fact that a number of them are known to play an important rôle in industrial hygiene.

The extent to which some of the heavy metals are present in food products is indicated in the following reports. According to analyses published recently by Birckner (1) the quantity of zinc in oysters may reach 1.15 gm. per kilo, in baker's yeast 0.414 gm. per kilo. Dried eggs, according to analyses made in the Bureau of Chemistry, may contain as much as 2.4 gm. per kilo; while Hiltner and Wichmann (2) reported 2.9 gm. of zinc per kilo in oysters. The results of similar analyses for copper are also interesting. The quantities in oysters varied between 52 and 539 mg. per kilo, but in one instance, with drained oysters, 1487 mg. per kilo were found. According to Leach (3), from traces up to 2.75 gm. of copper per can were found in canned vegetables. The same writer states that the quantity of tin in canned vegetables may amount to about a third of a gram per kilo. According to Harrington (4), 0.25 gm. of nickel sulphate may be present in green peas. Tin has been found in a number of foods in amounts of 10 to 450 mg. per kilo, the quantity even reaching so high a figure per kilo as 1.5 gm. Lead also is present in very small quantities but in view of the clinical and experimental evidence concerning this metal, as shown by the work of Straub (5), Erlenmeyer (6), Legge and Goadby (7), and Oliver (8), very small doses cannot be considered safe when taken into the body habitually — a contingency which must occur if it is present in foods.

The effect of heavy metals on health is therefore a matter of prime importance — a fact which emphasizes the need for more extensive investigation — for only by obtaining incontestable evidence of their poisonous effects can preventive methods be adopted. But a better understanding of the action of heavy metals is needed in other connections. Heavy metals are also known to cause injurious effects of a serious character in persons exposed daily and for years to their action in many important industries. It is well known that lead poisoning occurs in a large number of trades. Oliver (8), Legge and Goadby (7) in England, and Alice Hamilton (9) in this country, who have for years been directing attention to industrial lead poisoning, state that lead is employed in about 150 industries. Zinc is also known to be an important etiological factor in the causation of certain industrial diseases. The symptoms of poisoning observed in braziers and brassworkers may be mentioned as some of the abnormal changes produced by this metal. Copper is not commonly considered an industrial poison, but according to Hayhurst (10) its astringent and caustic salts

* Presented before the New York Academy of Sciences, Section of Astronomy, Physics and Chemistry, Feb. 2, 1920. Received for publication March 3, 1920.

may produce contact poisoning in workers handling them. Cases of poisoning with manganese have been reported within recent years by several observers. Casamajor (11) reported ten cases with peculiar neurological symptoms and a number of cases have been described by Emden (12), by von Jaksch (13), and very recently by Edsall and his collaborators (14). Nickel in metallic form was considered to be without toxic effect, but experiments carried out by Armit (15) indicate that it is by no means free from poisonous properties. This is especially the case when nickel is in combination with carbon monoxide forming nickel carbonyl, the fumes of which when inhaled produce serious and even fatal symptoms. The effect, according to Armit, is not due to the carbon monoxide present but to nickel in the form of a slightly soluble compound or in a fine state of subdivision. Other heavy metals, such as mercury and certain compounds of iron, vanadium and chromium may also be mentioned in this connection as causative agents in the production of occupational diseases.

Further and wholly different reasons from these suggest also the need of further inquiry into the mode of action of heavy metals. In the absence of accurate information on this subject, federal and state officials may, and sometimes do, impose unnecessary restrictions on the manufacture and sale of various food products, leading to unnecessary waste of foodstuffs and to needless disturbance of important industries with consequent economic loss, which in these days of the high cost of living is a matter for serious consideration.

To aid in safeguarding the public health and in preventing economic losses to the community and to the individual, the writer several years ago planned extensive investigations into the action of heavy metals. Some of the substances in question have already been studied by him and his collaborators, but much more remains to be done. Owing to circumstances over which he had no control, the work was interrupted, but the writer hopes to resume these urgently needed investigations. Meanwhile, preliminary observations on the subject are presented in the following report.

Experiments with Zinc

Zinc in our experiments was given to different animals, usually in the form of malate but sometimes as the chloride. The salts were fed to animals in their food and tests were made of the effects on different organs. The feeding experiments were carried out on rats for periods of two to four months, and on cats for from ten days to two months. No effects were noticed on the general health, although considerable quantities of the metal were given, much more than could possibly be taken with food by a human being in the course of a day. Rats weighing 150 to 200 gm. which received 10 to 15 mg. of zinc acetate daily for four months kept their weight, though in some cases there seemed to be some disturbance of renal function. Cats received daily 50 mg. of zinc in the form of malate. Some of them gained in weight 23 to 26 per cent.; one cat gained 4 per cent.; three cats showed a loss of 3 to 5 per cent. The literature on this subject shows contradictory results. According to Sacher (16), amounts up to 34 mg. of zinc per kilo given daily in their food to rabbits for from five to thirty days proved harmful, and 6 to 28 mg. proved harmful to cats. Sacher reported loss of appetite, albuminuria, congestion of the kidney, and hemorrhage into the gastric mucosa. On the other hand, it was reported by Lehmann (17) that 0.5 gm. of zinc per day, fed daily for 242 days, failed to cause any untoward effects. Brandl and Scherpe (18) fed various amounts of zinc salts to different animals. Dogs, rabbits, and guinea pigs which received daily 1 to 2

mg. of zinc as malate for seventy-seven to eighty days failed to show any effects. Young dogs that were fed 8 to 9 mg. daily for 127 days continued to grow and gain weight. In another experiment on two dogs, increasing doses of zinc were administered for fifteen days until in one case a dose of 420 mg. of zinc per kilo was given, but no symptoms of injurious action of the metal were observed. Rabbits, however, seemed to be less resistant. Up to 8 mg. per day were borne without any apparent injury, but when the dose was increased to 437 mg. per kilo daily and given for some time, there was loss of appetite and albuminuria. On autopsy the kidneys were found congested and showed the presence of cloudy swelling; there was also hemorrhage into the mucous membrane of the stomach.

Although the action of zinc when taken by mouth, even in comparatively large amounts, is not very injurious, the case is quite different when zinc is introduced directly into the circulation and comes in contact with various organs. The writer and Miss Connet (unpublished experiments) have shown that when a nutrient solution to which a small quantity of zinc is added is perfused through the isolated frog heart, a change in its activity is at once noticed. Heart action becomes weak, the amplitude becomes visibly smaller with each beat, and the action becomes irregular, auricles and ventricles ceasing to work in harmony. This may go on as long as the heart is exposed to the solution; not infrequently the change caused by the zinc may continue even after the perfusion has been discontinued. A second treatment, after a considerable interval of time, produces more marked effects, thus suggesting cumulative action. In heart-perfusion experiments, carried out by me with the collaboration of Miss Connet, with a solution of 1:50,000 of zinc malate in Ringer's solution or one part of zinc to about 200,000, one minute was sufficient time to produce very marked cardiac depression. The injury to the heart was very striking when stronger solutions of zinc malate were used. One-twenty-fifth of 1 per cent. caused depression of heart action which tended to be permanent, while in other cases recovery was very slow. With a concentration of 1:1000 of zinc malate in Ringer's solution, permanent arrest of the heart was observed.

The depressing effect of zinc is not confined, however, to the heart. Mitchell and I (19) carried out experiments with zinc salts on different animals and found that smooth muscle is likewise affected by zinc. Segments of the intestines, a few centimeters long, removed from animals under deep anesthesia and suspended in Locke's solution, ceased their movements when a sufficient amount of zinc malate was added. A solution of N/2000 of zinc malate produced a very distinct diminution in the force of rhythmic contraction, and when the concentration of zinc was doubled the contractions became very weak and irregular at the end of forty-five or fifty minutes. When the solution containing zinc was removed and another solution without zinc substituted, there was only partial recovery of function. When the amount of zinc was increased still more, there was complete abolition of function, which in some cases was permanent.

That zinc is a general protoplasmic poison is further indicated by the fact that it has a decided influence on other organs than the heart. According to Harnack (20) zinc caused in higher animals symptoms of nervous depression, muscular paralysis, and paralysis of respiration and of the circulation. According to the observations of several investigators, zinc, like some of the other metals such as mercury, uranium and chromium, may produce serious injury to the kidney. This, as shown by D'Amore, Falcone and Marmaldi (21) may be associated with glycosuria. Recently Dr. Wise and I (22) carried out experiments with

zinc malate. We found that a gram of zinc malate fed to animals may be followed by albuminuria. The effect was more constant and the damage more pronounced if a small quantity of zinc was introduced directly into the circulation. Ten mg. of zinc per kilo injected intravenously caused very marked injury to the kidney; a large amount of albumin and many casts were present in the urine. In a large proportion of cases death occurred within a few days. Associated with these renal changes was the presence of sugar in the urine as well as an increased concentration of sugar in the blood, amounting at times to 30 or 35 per cent. The amount of sugar in the urine of rabbits did not exceed 0.3 per cent., but in cats it reached 2.75 per cent. after subcutaneous injections. Glycosuria was also observed in dogs after subcutaneous injections of zinc salts, but the quantity was less than in the urine of cats.

The elimination of zinc after it reaches the circulation has been studied by several workers, the results obtained being somewhat contradictory. In co-operation with Rieger and Treuthardt (23), I was able to obtain interesting data on this subject. We found that zinc is absorbed from the intestine and that the intestinal canal is also the main channel of elimination, the kidney playing a very subordinate rôle in ridding the body of the metal. No zinc was found in the stomach of animals which received zinc salts intravenously. A study of its distribution in the body indicated that it was stored up in considerable amounts in the liver; it was almost always found in the skin and in the muscles, but none was present in the brain.

Experiments with Tin

Another metal which is of frequent occurrence in foods is tin. The enormous development of the canning industry makes it particularly desirable that accurate information regarding the physiological effects of tin should be obtained. I carried out feeding experiments with the tartrate and chloride on cats, administering daily 10 to 50 mg. of tin in the form of these salts, mixed with the food of the animals. Ten mg. of tin per kilo, fed for twenty-three days and followed by 20 mg. per kilo for three months failed to show any harmful effects. There was, on the contrary, a gain in weight of 100 to 400 gm. But when the dose was increased to 30 mg. per kilo and fed for about two and a half months there was a loss of weight amounting to $10\frac{1}{2}$ per cent. in two cats. The decrease was much faster in these two cases when the dose was increased to 50 mg. of tin per kilo. At the end of four weeks' feeding of such a dose, the loss in weight of one cat amounted to 10 per cent.; in the other it was 16 per cent. Three other cats similarly treated were more resistant, as they lost only 5 per cent. of their weight during the four weeks. But a sixth cat which weighed 1400 gm. lost 450 gm. and died at the end of the period. It is evident, therefore, that moderately large amounts of tin given daily with food for fairly long periods may prove harmful to health. It might be added that the chloride of tin is probably more injurious than the tartrate, since the marked emaciation occurred in the cat which received the chloride. It is possible, however, that the decreased resistance to tin was due to some abnormal condition in this cat, since two other cats belonging to the same series of experiments received the same amounts of tin chloride and survived with a loss of weight amounting to only 5 per cent.

Rieger, Treuthardt and I (24) also studied the fate of tin in animals. After the subcutaneous injection of some of its salts, the metal was present in the urine and in the contents of the stomach and of the intestine. Smaller amounts, however, were eliminated by the kidneys than by the intestines, tin resembling zinc in this respect. It is of interest to note that the rate of

excretion of these two metals was somewhat different, the amount of tin excreted by the kidney being greater than that of zinc. In some experiments almost as much tin was eliminated by the kidneys as by the intestines, but this was never the case with zinc. That tin is very slowly absorbed from the intestines was shown by the fact that after feeding considerable quantities daily and for weeks, very small amounts only were found in the urine. This is not at all surprising in view of the fact that the salts of tin are so insoluble. When they are fed for a long time, however, absorption may take place, for small quantities were recovered from animals that had received the tartrate for from three to four months. It is quite probable that after tin has been fed for a certain time changes in the mucosa occur which increase its permeability to the metal. This is supported by observations by Buchanan and Schryver (25), who detected tin in the urine of dogs during the second and third weeks of the feeding of tin salts, but not during the first week of the experiment.

The results of experiments carried out on other heavy metals are of interest in this connection. Miss Connet and I (unpublished results) made a number of tests with copper sulphate on the isolated heart of the frog. A solution of 1:10,000 produced prompt depression of cardiac action. At the end of one minute's exposure to the salts, the heart became very feeble and remained permanently in this condition. Much more pronounced was the effect of cadmium. A solution of 1:1,000,000 of the acetate in Ringer's solution caused a very noticeable diminution in the force of the heart, without changing the rate to any appreciable extent. A solution of 1:100,000 produced about the same effect as a concentration of copper sulphate that was ten times as strong.

Experiments with nickel acetate were made on the heart as well as on the isolated intestine. The effects were different from those obtained with the other heavy metals. When the frog heart was perfused with 1:10,000 nickel acetate in Ringer's solution, the contractions became less frequent but more forcible, and recovery occurred after perfusion with nickel acetate was discontinued. A more detailed study of the influence of nickel, copper, cadmium, and zinc on the isolated heart will appear shortly in the *Journal of Pharmacology and Experimental Therapeutics*. The report will also include experiments with cobalt, iron, manganese and uranium. The reaction of the isolated intestine to nickel acetate, which was studied by Mitchell and myself (19), indicated a very pronounced depression with strong solutions only. Weak solutions caused primary depression followed by stimulation.

Of the other heavy metals to which attention might be called, lead is the most toxic. Straub and his pupil, Erlenmeyer, have shown that less than 1 mg. of lead per kilo when present in the circulation is sufficient to cause bulbar paralysis in cats within sixty days. In experiments on the isolated intestines of animals the writer and Levine (unpublished experiments) found that small quantities are markedly toxic, which is particularly interesting in view of the fact that lead has been shown to be present in small quantities in certain food products. Baking powder contains about 10 mg. of lead per kilo, but it is doubtful if even this amount should be permitted in articles intended for human consumption. According to Professor Rubner and Dr. Smith, 0.36 mg. of lead is the minimum of safety quoted by Oliver. According to Oliver (8), 0.2 to 1.5 mg. of lead in a liter of water cause lead poisoning when taken for several months. A note of warning may therefore be sounded to those who are in a position to decide whether the public should be permitted to use food products that contain any lead at all.

In conclusion, it may be pointed out that some of the heavy metals considered are very poisonous, producing degenerative changes in some organs and causing functional disturbances in others. At the same time it is necessary to recognize the very important fact that the heavy metals are apparently well borne for a considerable length of time when taken with food. At least no injurious effects can be traced to their ingestion, which indicates that the intestinal canal probably exerts a protective action against the poisonous action of these metals and their salts. It is necessary to bear in mind, however, that disturbance of function of the intestinal canal or structural changes of the mucous membranes of the stomach and intestines may occur, in which case the protective action of these organs may cease and the metals may thus gain access to the different organs causing serious and even irreparable damage. It is advisable, therefore, that notwithstanding the apparent harmlessness of some of the heavy metals when taken with foods, caution should be exercised in permitting the manufacture and sale for human consumption of foods containing even small amounts of such metals. The public is entitled to the benefit of the doubt in the case of those metals, the harmlessness of which has not been firmly established.

BIBLIOGRAPHY

1. Birckner, V.: The Zinc Content of Some Food Products. Jour. Biol. Chem., 1919, **38**, 191.
2. Hiltner, R. S., and Wichmann, H. J.: Jour. Biol. Chem., 1919, **38**, 205.
3. Leach, A. E.: Food Inspection and Analysis. Revised by A. L. Winton. New York, John Wiley & Sons, Inc., 1913.
4. Harrington, C.: A Manual of Practical Hygiene. Revised by M. W. Richardson. Philadelphia, Lea & Febiger, 1914.
5. Straub, W.: Ueber chronische Vergiftungen speziell die chronische Bleivergiftung. Deutsch. med. Wchnschr., 1911, **37**, 1469.
6. Erlenmeyer, E.: Der Mechanismus der chronischen Bleivergiftung nach experimentellen Studien. Ztschr. f. exper. Path. u. Therap., 1913, **14**, 310.
7. Legge, T. M., and Goadby, K. W.: Lead Poisoning and Lead Absorption. London, Edward Arnold, 1912.
8. Oliver, Sir Thomas: Lead Poisoning. London, H. K. Lewis, 1914.
9. Hamilton, Alice: Lead Poisoning in American Industry. Jour. Indust. Hyg., 1919, **1**, 8.
10. Hayhurst, E. R.: Diseases of Occupation and Vocational Hygiene by G. M. Kober and W. C. Hanson. Philadelphia, P. Blakiston's Sons & Co., 1916, p. 15.
11. Casamajor, L.: An Unusual Case of Mineral Poisoning Affecting the Nervous System: Manganese ? Jour. Am. Med. Assn., 1913, **60**, 646.
12. Emden, H.: Zur Kenntniss der metallischen Nervengifte (Ueber die chronische Manganvergiftung der Braunsteinmüller). Deutsch. med. Wchnschr., 1901, **27**, 795.
13. Von Jaksch, R.: Manganese Toxicosis. Jour. Am. Med. Assn., 1913, **61**, 1042.
14. Edsall, D. L., Wilbur, F. P., and Drinker, C. K.: The Occurrence, Course and Prevention of Chronic Manganese Poisoning. Jour. Indust. Hyg., 1919, **1**, 183.
15. Armit, H. W.: The Toxicology of Nickel Carbonyl. Jour. Hyg., 1907, **7**, 525.
16. Sacher, A.: Zur Kenntniss der Wirkung der Zinksalze. Arb. a. d. Pharmakol. Inst. zu Dorpat, 1893, **9**, 88.
17. Lehmann, K. B.: Einige Beiträge zur Bestimmung und hygienischen Bedeutung des Zinks. Arch. f. Hyg., 1897, **28**, 291.
18. Brandl and Scherpe: Ueber zinkhaltige Aepfelschnitte nebst Versuchen über die Wirkung des äpfelsauren Zinks. Arb. a. d. k. Gsndhtsamte, 1899, **15**, 185.
19. Salant, W., and Mitchell, C. W.: The Influence of Heavy Metals on the Isolated Intestine. Am. Jour. Physiol., 1916, **39**, 355.

20. Harnack, E.: Ueber die Wirkung der "Emetica" auf die quergestreiften Muskeln. Arch. f. exper. Path. u. Pharmakol., 1875, **3**, 44.

21. D'Amore, L., Falcone, C., and Marmaldi, L.: Action toxique et altérations anatomique produites par l'ingestion de l'oxyde de zinc. Compt. rend. Soc. de biol., Nov. 12, 1892, N.S. **4**, 335.

22. Salant, W., and Wise, L. E.: The Production of Glycosuria by Zinc Salts. Jour. Biol. Chem., 1918, **34**, 447.

23. Salant, W., Rieger, J. B., and Treuthardt, E. L. P.: The Distribution and Elimination of Zinc and Tin in the Body. Jour. Biol. Chem., 1918, **34**, 463.

24. Salant, W., Rieger, J. B., and Treuthardt, E. L. P.: Absorption and Fate of Tin in the Body. Jour. Biol. Chem., 1914, **17**, 265.

25. Buchanan and Schryver: Local Government Board (Medical Department), Report of Inspector of Foods, London, 1908, p. 18.

Vienna, 5. March 1920.

Dear Sir,

Will you kindly excuse, if we the members of the Viennese factory-inspection ask of you as our American colleagues the favour to send us through the newly established "American Relief (Ware-House) Action" some parcels containing different articles of food.

The shortness of provisions in Vienna is now beyond all description and we certainly would not dare to appeal to you for assistance if the famine had not already undermined the health of our families and especially of our children. To the Viennese factory-inspection belong now 23 gentlemen- and 3 ladies-inspectors, besides 14 assistant clerks.

Please believe us that we immediately will repay our debts as soon as the value of our money will rise. Until then we would be glad to be of use to you. Perhaps we could contribute to your American special magazines and journals some essays about technical, hygienical or sozial questions. Let us kindly know in which of these topics you would take most interest.

Please send your answer to the following address:

Gewerbe-Oberinspektor Karl Hausk, Vienna, I. Hofgartenstrasse 3, Austria, (Staatsamt fur soziale Verwaltung).

Beleeve me, dear Sir, to be

very truly yours

Wird wärmstens befürwortet !

Wien, am 6. März 1920.

Der Hofrat

Zentral-Gewerbe-Inspektor:

gez. d. Tauss

We warmly recommend this request

Vienna, 6th March 1920.

Chief-Factory-Inspector.

gez. Tauss

APPEAL FOR FOOD FROM THE FACTORY INSPECTORS OF VIENNA

At the request of Dr. George M. Price, Director of the Joint Board of Sanitary Control in the Cloak, Suit and Skirt and the Dress and Waist Industries, we are glad to reproduce the preceding appeal for food, received by Dr. Price from the members of the Viennese factory-inspection service. Dr. Price writes, "I am sending you herewith an appeal which I have received from Vienna from some of the inspectors I have known when I visited there. I have done all I could personally and have also induced the New York State Industrial Commission to make an appeal, and it seems to me it would be well to have this printed in your Journal, as well as to make arrangements for some contributions from these highly competent authorities." The preceding page contains a photographic reproduction of the letter received by Dr. Price.

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

The Medical Aspects of Mustard Gas Poisoning. By Aldred Scott Warthin, Ph.D., M.D., Professor of Pathology and Director of the Pathological Laboratories of the University of Michigan, Ann Arbor, Michigan; and Carl Vernon Weller, M.S., M.D., Assistant Professor of Pathology, University of Michigan. Cloth. Pp. 267 with illustrations, bibliography and index. St. Louis: C. V. Mosby Company, 1919.

Teaching the Sick. A Manual of Occupational Therapy and Re-education. By George Edward Barton, A.I.A., Director of Consolation House and President Consolation House Convalescent Club, Inc. Cloth. Pp. 163 with illustrations and index. Philadelphia: W. B. Saunders Company, 1919.

The Narcotic Drug Problem. By Ernest S. Bishop, M.D., F.A.C.P., Clinical Professor of Medicine, New York Polyclinic Medical School; Member Narcotic Committee, Conference of Judges and Justices of New York State; Committee on Habit Forming Drugs, Section on Food and Drugs, American Public Health Association, etc. Pp. 165 with appendix and index. New York: The Macmillan Company, 1920.

The Labor Situation in Great Britain and France. By the Commission on Foreign Inquiry of the National Civic Federation, 1919. Cloth. Pp. 433 with index. New York: E. P. Dutton & Company, 1919.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | JULY, 1920 | NUMBER 3

HEALTH HAZARDS IN THE PEARL BUTTON INDUSTRY*

E. G. BIRGE,† M.D. AND L. C. HAVENS, M.D.

From the Division of Preventive Medicine and Hygiene, State University of Iowa, Iowa City, Iowa

THE pearl button industry has always been considered as a dusty trade and consequently the tuberculosis incidence among the workers has been assumed to be high. There is, however, little definite data in the literature on the subject though the investigations which have been made seem to bear out this assumption. Thus, out of 390 deaths among the pearl button workers in Vienna between 1895 and 1905, 69.7 per cent. died from consumption, and Teleky in an examination of 159 pearl button workers in 1907 found that only ninety-three had normal lungs (1). Of 127 cases studied by one insurance company, forty-eight, or 37.8 per cent., died of pulmonary tuberculosis and fourteen, or 11 per cent. additional, died of other respiratory infections. Kober and Hanson are also authority for the statement that osteomyelitis, especially of the bones of the forearm and hand, occurs frequently among button workers. Dyspeptic conditions and catarrhal affections are also stated to be common.

The pearl button industry of the United States affords employment for about 5000 persons. About one-third of this number is employed in Iowa and the industry is worth about $5,000,000 annually to this state. One town alone employs about 1500 persons in the manufacture of pearl buttons, and it was consequently felt that a detailed survey of the industry in this town would be of value. The survey includes not only a study of the dust hazard but of all health hazards found to occur, together with an investigation of general living conditions, the type of workers, and any other hygienic considerations peculiar to this industry.

DESCRIPTION OF PROCESSES INVOLVED

The process of making pearl buttons involves more or less dust from start to finish. The shells are cleaned and then soaked in water for a considerable period of time to make them less brittle. The "blanks" are then cut from the shells. This process of cutting the blanks is a wet process. Jets of water playing on the saw cause a fine spray to fly continually from the saw, covering the objects in the near vicinity and flying in the face of the cutter. The blanks are then ground by being passed on a belt beneath an emery wheel making about 1000 revolutions per minute, the buttons thus being reduced to uniform thickness.

* Received for publication March 3, 1920.
† Deceased Feb. 4, 1920.

This process is dry and involves a large amount of dust which is partially controlled by means of suction apparatus. The blanks are then ready for the holes and patterns to be made on so-called automatic machines or chucks — a process involving the production of dust. Although in this case there is not so much dust produced as in the grinding process, it is more difficult to control. The buttons are next polished, usually by chemical processes, and then sorted and carded. This, in brief, covers the processes of pearl button manufacture.

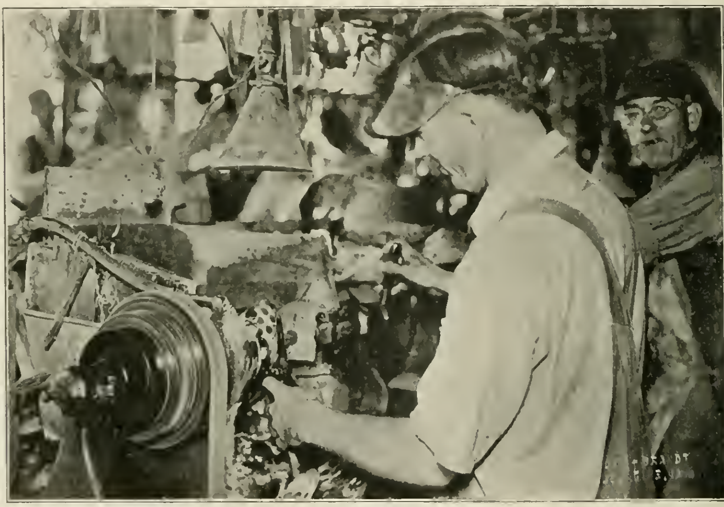

Fig. 1. — Cutting room, showing method of cutting the blanks from the shell. Note the dust dried on the lamp shade and on the worker's arm.

General Hygienic and Sanitary Conditions

In the town surveyed there are eight or ten larger factories employing from 100 to 300 people — factories which include all stages of the processes of button making. In addition, there is a considerable number of plants of smaller size which, however, only cut blanks. The problem is more or less complicated by the shifting character of the workers, few of them working very long at a time in any one factory. Furthermore, many work only during the fall and winter months, leaving the factory in the summer to spend their time digging clams. Such open-air work during a part of the year undoubtedly has a beneficial effect in counteracting any deleterious influences connected with the inside work in the factory. The work is all piece-work, the employees being paid by the quantity they produce instead of a definite sum per hour. In view of this, the problem of fatigue enters into consideration.

The general hygienic and sanitary conditions in the larger factories are, on the whole, fair. The dust elimination is fairly well controlled and the larger manufacturers always look for better methods of dust elimination. In six plants the ventilation is only fair; in two plants, ventilation is obtained by means of large fans and by suctions, and the conditions in this respect

are excellent. None of the plants have ideal toilet facilities, although in only one of the larger plants are the toilet facilities inadequate. No provision is made for sick benefit. The work being, as stated, all piece-work the employees are more or less free to work as they see fit, and in five of the plants studied no effort was made to determine the cause of absence from work.

The hygienic construction is good in four of the plants, and bad in the other four, many of the rooms being poorly lighted and poorly ventilated. Viewed from a hygienic and sanitary standpoint, the conditions in the cutting rooms are always the poorest of any of the processes (Fig. 1). The rooms are usually damp, dirty and dark. The streams of water which trickle over the saws, keeping them cool and helping to eliminate the dust, run down the edges of the benches into a trough. This trough is usually used as a cuspidor except where the cutters spit upon the floor. There is usually more or less water on the floor and the cutters work constantly with their hands in cold water. This seems to have an effect in lowering the resistance to infection, organisms being carried mainly by the organic material on the shells and entering the skin through small cuts and abrasions. One plant soaks the shells in an antiseptic solution and reports a very low incidence of infections of this character. While the water playing over the saws is intended to eliminate dust, the fine spray produced in cutting the shells flies through the air almost as freely as dry dust. This spray is laden with shell dust and the cutters are constantly inhaling the spray.

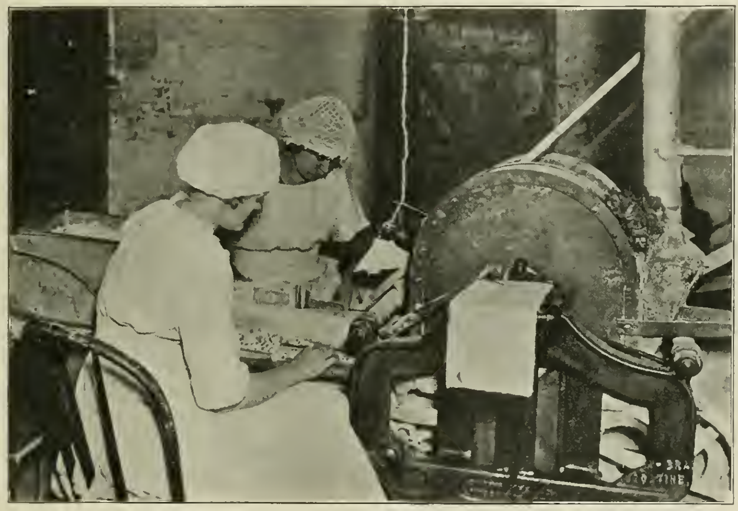

Fig. 2. — Grinding room, showing the process of grinding button blanks to uniform thickness.

In the grinding rooms, women are employed to a large extent. Their work is to place the blanks on a belt passing under an emery wheel which grinds down the blanks to uniform thickness. The emery wheel itself is incased in a hood from which the air is exhausted by means of suction, carrying away a large portion of the dust. There is another suction device beyond the emery wheel which sucks the buttons off the belt, together with a considerable proportion of

the dust (Fig. 2). All the dust, however, is not removed. The grinders' hands are always covered with the fine shell dust and all the objects in the room are laden with it.

In the automatic room the holes are bored in the buttons by the chuck and the desired patterns are cut. The dust elimination here is a complicated problem because the processes of boring and grinding take place at different points on the machine and all of the processes are productive of dust (Fig. 3). Here as in the grinding room the workers are mostly girls, and their hands are always covered with dust. Dust is observed on the machines and on all objects in the room. These rooms are usually ventilated by fans which exhaust the air. Dust is exhausted from the machine through pipes usually into the open air above the roof of the factory, although one plant has installed a system of baffles which collect the dust and prevent it from escaping into the outside air.

In the polishing room there seems to be no special health hazard, although in one plant steam escaping into the room was sufficient to constitute a hazard. In the sorting room the main hazards are fatigue from the monotonous character of the work, and eye strain. There is no special dust problem involved here.

General cleanliness in the larger plants is, on the whole, good. The cutting rooms, however, with one exception, leave much to be desired. The smaller plants vary in size from one room employing two men up to establishments employing twenty or thirty men. These smaller plants cut blanks only, no grinding or polishing being done. The general hygienic and sanitary conditions in these smaller plants are universally poor. The toilet facilities are inadequate and the methods of eliminating the water used in the process are more or less haphazard. On the whole, the smaller plants compare unfavorably with larger ones.

Although there are on all the grinding machines and in the boring machines powerful suction devices, dust is the most important health hazard. The amount of dust produced is so enormous that it is difficult to devise any method which will eliminate it completely. Much dust sticks to the belts and is continually thrown off into the air of the rooms. The boring process is especially difficult to control and the boring machines are more or less covered with dust at all times. The general health of the employees is apparently good. The majority of them, however, are of a low standard of mentality and fail to appreciate or take advantage of any means employed to decrease the health hazards in connection with their work. Although in one or two of the plants washing facilities are adequate, yet in these as in all of the plants the hygienic and sanitary principles practiced are far from ideal and much dust is probably ingested and inhaled from the hands of the workers.

Catarrhal conditions are common and the workers take it practically as a matter of course that persons engaged in this industry are more or less universally subject to catarrh.

General Considerations Regarding the Dust Hazard

It will be seen from Figure 2 that the hoods and suction devices employed in the grinding are of faulty construction. Although the hood completely covers the wheel, the end of the belt is left open and much dust is thrown off from it as the belt passes over the pulley. Much more dust could undoubtedly be eliminated by having the end of the belt as well as the emery wheel completely covered, instead of the present device by which the buttons are sucked from the belt through a narrow slotted opening which removes the dust inadequately.

In the cutting room, the water used is supposed to remove completely all dust, and dust is not considered by the manufacturers to be a hazard in this part of the work. As will be seen later, however, in the analyses of the air for dust, the water plays a very small part in the elimination of dust in this process, the dust being present in the air in the cutting room in the same amounts as in the grinding room. Jets of water which play over the saw are thrown into a fine spray as the shell is cut. This spray is heavily laden with dust as can be seen from the dried dust on the electric light shades and other objects in the room. Furthermore, this spray is inhaled and is so fine that it dries in the air, giving rise to an excessive dust content.

In the automatic room the control of the dust is a difficult problem owing to the various steps in the process which take place at different points, all involving the production of dust. The method of dust removal at present in use consists of a suction pipe which runs down close to the chuck where most of the dust is produced, a considerable portion of the dust being removed in this way.

Fig. 3. — Automatic room, where holes are drilled and patterns ground on the buttons. Note that each chuck has a suction pipe placed near it to remove dust.

Dust Analyses

In order to determine how much dust was present in the different rooms, analyses were made of the air. The method used was the Palmer water-spray apparatus (2) (3) (4), 100 cubic feet of air being passed through the apparatus for each analysis at the rate of about 4 cubic feet per minute. Table 1 shows the amount of dust per 100 cubic feet in the various rooms of the factory. It will be seen from this table that equally as much dust was found in the cutting room as in the grinding room in spite of the fact that in the former the wet process is used, whereas in the grinding room the process is dry. A further point brought out by these analyses is the fact that, although apparently from observation of the

process dust is produced in greater quantities in the grinding rooms than in the automatic rooms, the converse is true. This is undoubtedly due to the fact that less efficient means are used in the automatic room for the elimination of the dust. As shown by the analyses of the air, dust is not a hazard in the sorting room, the amount of dust in the air being no greater than the normal quantity.

TABLE 1.—AIR ANALYSES FOR DUST

Place	Mg. of Dust per 100 Cu. Ft.	
	A.M.	P.M.
Cutting Room	20.5	25.6
Grinding Room	26.0	31.4
Automatic Room	40.6	26.5
Sorting Room	..	2.0

No attempts were made to determine the size of the dust particles owing to the fact that in the sample of water they tend to clump together into large particles which are unsatisfactory for microscopic examination. The dust produced, however, is a very fine, impalpable powder. Owing to the fact that the collections were made at some distance from the laboratory, a considerable amount of time elapsed before the specimens could be examined. Microscopic examinations were thus rendered unsatisfactory. Table 1, consequently, gives only the total amount of dust in the air. The dust appears to be of a uniform size, all of the particles being very small.

Incidence of Tuberculosis

In order to ascertain the incidence of tuberculosis and other pathologic conditions of the lungs existing among the pearl button workers, a survey of the employees of several plants was made.* From the data obtained, it was found that the total incidence of tuberculosis in the community was 1.2 per cent.; the incidence among persons not employed in the pearl button industry was 1.02 per cent.; while the morbidity rate for tuberculosis among the pearl button workers themselves is shown by this report to be 2.6 per cent. Such statistics are open to criticism, and deductions from data so obtained are likely to be fallacious unless great care is taken in considering the factors which are involved. The figures for the amount of tuberculosis among the button workers are undoubtedly lower than is actually the case. It is an observed fact that dust, as a factor in the production of pulmonary tuberculosis, requires a period of years for its action — a fact which is brought out in Table 2. It was found that twenty-two out of thirty-three cutters examined were clinically tuberculous and only six out of the thirty-three gave negative lung examinations. All of these twenty-two cases, however, occurred among those who had worked at least five years at the cutting trade and all but two had worked ten years or longer. The figure 2.6 per cent., representing the incidence of infection among the button workers, includes all button workers, many of whom had been employed for less than a year — a period of time too short for the effect of the dust to be shown.

TABLE 2.—RESULTS OF PHYSICAL EXAMINATIONS OF CUTTERS

Length of Occupation	Number Examined	Positive Tuberculosis	Other Respiratory Disorders	Negative Respiratory Conditions	Rheumatism	Indigestion	Hand Infections
Under 1 year	0	0	0	0	0	0	0
1– 2 years	0	0	0	0	0	0	0
2– 5 "	1	0	0	1	0	0	0
5–10 "	3	2	0	1	1	1	1
10–15 "	12	8	4	3	3	2	1
15–25 "	11	6	1	1	3	3	0
Unknown	6	6	0	0	0	0	0
Total	33	22	5	6	7	6	2

* We are indebted for the physical examinations from which these conclusions are obtained to the kindness of Drs. W. W. Daut and E. M. Stiers. For other results embodied in this survey, we are indebted to the files of the Muscatine Welfare Board, through the kindness of Miss Woodward, the public health nurse of the boar d.

Table 4 shows eleven persons out of twenty-five examined who gave a history of the frequent occurrence of respiratory diseases other than tuberculosis. Such conditions as colds, catarrh and bronchitis, many of which are undoubtedly incipient tuberculosis, undiagnosed, and which if not actually incipient tuberculosis lower the resistance to infection with tuberculosis, throw light on the mode of operation of the dust in rendering the lungs susceptible to this type of infection.

TABLE 3.—RESULTS OF PHYSICAL EXAMINATIONS OF GRINDERS

Length of Occupation	Number Examined	Positive Tuberculosis	Other Respiratory Disorders	Negative Respiratory Conditions	Rheumatism	Indigestion
Under 1 year	1	0	0	1	0	1
1- 2 years	2	1	1	0	0	1
2- 5 "	6	4	2	0	2	4
5-10 "	1	0	0	1	0	0
10 "	1	1	0	0	0	1
Unknown	1	1	0	0	0	0
Total	12	7	3	2	2	7

Table 5 shows a high incidence of tuberculosis and other respiratory diseases among the sorters where no dust hazard exists. All of these five sorters, however, gave a family history of tuberculosis, it being very common for the father, brother or other relative to be employed in the cutting or grinding departments. In consequence, it is safer to assume that the home conditions were responsible for the high incidence among the sorters rather than the conditions under which they worked.

TABLE 4.—RESULTS OF PHYSICAL EXAMINATIONS OF AUTOMATIC MACHINE OPERATORS

Length of Occupation	Number Examined	Positive Tuberculosis	Other Respiratory Disorders	Negative Respiratory Conditions	Rheumatism	Indigestion
Under 1 year	5	0	2	3	0	0
1- 2 years	7	0	3	4	1	2
2- 5 "	6	0	3	3	2	3
5-10 "	6	0	2	4	3	2
10 "	1	0	1	0	0	0
Total	25	0	11	14	6	7

Other Health Hazards

In the examination of the button workers, rheumatism, indigestion, eye strain and other incidental health hazards were considered. It will be seen from the above tables that there seems to be a rather high incidence of rheumatism and indigestion, but it is doubtful if this incidence is higher than would be found in any other group of persons examined.

The number of hand infections among the cutters as shown by these examinations seems to be low, contrary to the general impression that such infections are rather common.

TABLE 5.—RESULTS OF PHYSICAL EXAMINATIONS OF SORTERS

Length of Occupation	Number Examined	Positive Tuberculosis	Other Respiratory Disorders	Negative Respiratory Conditions	Rheumatism	Indigestion
1- 2 years	2	1	1	0	0	1
2- 5 "	2	1	1	0	0	0
5-10 "	1	1	0	0	0	0
Total	5	3	2	0	0	1

Among the sorters, eye strain is a common complaint due to the nature of the work. The buttons must be sorted rapidly into the different grades; this requires concentration and close attention. Furthermore, the postures observed seemed in many instances to promote undue fatigue.

Living Conditions

The influence of home conditions on disease production and general health and welfare of workers is well known. In this investigation the number of rooms per person and the method of sewage disposal, as may

be seen from Table 6, were taken as the two best criteria of satisfactory living conditions. The living conditions are, on the whole, above the average for this class of workers. Only 16 per cent. have less than one room per person and 62 per cent. have more than one room per person. Most of the workers live in individual houses, 76 per cent. of which have sewer connections, the other 24 per cent. having privies which are more or less sanitary, varying to a considerable degree in the individual cases.

Home Work

Most of the work of sewing the buttons on the cards preparatory to shipment and sale is done at home, usually by members of the families of those employed in the factories. The objections that apply generally to home work, i. e., unhygienic surroundings, neglect of sanitary environment owing to time absorbed by work, low standards of living and spread of infection (5), apply to this work, but evidently to a less degree than usual. The homes visited were, on the whole, of the average type, viewed from a sanitary and hygienic point of view, and it is doubtful if the carded buttons constitute a significant factor in the spread of infection. In spite of these considerations, undoubtedly on general principles such work should be discouraged as much as possible.

TABLE 6.—HOUSING CONDITIONS OF FIFTY EMPLOYEES

Rooms per Person	Number of Employees	Per Cent. Employees
Less than 1	8	16
1	11	22
1-2	15	30
2	6	12
2-3	6	12
3	3	6
4	1	2
Total	50	100

General Discussion

The results obtained in this investigation seem to bear out the contention that dust is a serious health hazard in the pearl button industry. The cutters especially show a strikingly high incidence of tuberculosis. The dust does not show its effects in producing respiratory diseases, however, until a considerable period of time has elapsed. Death is due in an abnormal number of cases to tuberculosis but it does not occur early in life, usually operating about the prime of life or shortly thereafter, from forty-five to fifty-five years of age. Among the grinders and the automatic machine workers the relation of dust and the incidence of tuberculosis is also noticeable. It is not so clear cut, however, as among the cutters, since a large number of the workers in the grinding, automatic and sorting rooms give a family history of a father who was a cutter and developed tuberculosis. The home conditions, consequently, are undoubtedly factors in the excessive amount of tuberculosis among this class of workers.

There are a number of recommendations which can be made to improve the health of pearl button workers. In the first place, it is a fallacy that the use of water in the cutting room keeps down the dust. The amount of dust present in the air of the cutting rooms is as high as in the grinding and automatic rooms. Some method should be devised to prevent the dust-laden spray from flying into the workers' faces and being inhaled. Some efficient suction device should be employed in the cutting rooms, at least to the same extent as in the other departments where dust is produced. The amount of dust in the grinding rooms, however, indicates that a large part of grinding dust is removed. Although a great amount of dust is produced in this process, no more was found in the air of the grinding rooms than in the air of the cutting rooms. Much more dust could, however,

undoubtedly be removed by covering the end of the belt with a hood. A series of examinations showed more dust to be present in the automatic room than in either the cutting or grinding departments. This is due to the relative difficulty of removing the dust produced in this process. The dust, while not produced in the quantities that occur in the cutting and grinding rooms, is still in considerable amount and should be more effectually controlled. Throughout the factories it was observed that the workers' hands were covered with dust at all times, and undoubtedly ingestion plays an important part. Toilet and washing facilities and instructions to the workers in hygienic and sanitary principles would aid in the elimination of the dust hazard.

In most of the factories, especially in the larger plants, the ventilation is excellent. Lighting and other sanitary arrangements in general are very fair. The smaller plants, where only cutting of the blanks is done, are the places where the most unsanitary conditions were found. Most of these smaller establishments are dark, damp and unsanitary in every way, and means should be found by the community to control these smaller places.

Summary

Dust is a health hazard in the pearl button industry.

The amount of dust and the nature of its production make it difficult to control.

The incidence of tuberculosis among the employees is high but operates mainly after ten years' employment.

Further improvements not only in dust control but in general hygienic and sanitary equipment are recommended.

BIBLIOGRAPHY

1. Kober, G. M., and Hanson, W. C.: Diseases of Occupation and Vocational Hygiene. Philadelphia: P. Blakiston's Son & Co., 1916, p. 644.
2. Palmer, G. T.: A New Sampling Apparatus for the Determination of Aerial Dust. Am. Jour. Pub. Health, 1916, 6, 54.
3. Palmer, G. T., Coleman, L. V., and Ward, H. C.: A Study of Methods for Determining Air Dustiness. Am. Jour. Pub. Health, 1916, 6, 1049.
4. Smyth, H. F.: A Critical Review of Methods for the Study of Dust Content of Air. Jour. Indust. Hyg., 1919, 1, 140.
5. Duke, Emma: Home Work. Jour. Indust. Hyg., 1920, 1, 452.

DISPOSITION OF TUBERCULOSIS IN INDUSTRIAL ORGANIZATIONS*

JOHN S. BILLINGS, M.D.
Director, New York Tuberculosis Association

PULMONARY tuberculosis is the most difficult problem in industrial medicine, and one that is always present. This is because of its great frequency and its long duration, which often carries the case beyond the period of absence and amount of financial assistance usually allowed. The solution of the problem is further hampered by many underlying factors which have to be considered before the right course can be determined upon. Among these varying conditions are:

1. Personnel of organization: e. g.,
   a. Manual labor.
   b. Skilled labor.
   c. Clerical staff, etc.
2. Social and racial status of personnel, including:
   a. Wages.
   b. Intelligence, etc.
3. Working and welfare conditions of organization:
   a. Sanitation of place of work.
   b. Hours and rest periods.
   c. Rest rooms and lunch rooms.
4. Financial assistance available from:
   a. Company funds.
   b. Benefit associations.
   c. Local charitable organizations.
   d. Family resources.
5. Medical care provided by organization.
6. Local facilities for care:
   a. Hospitals.
   b. Sanatoria.
   c. Dispensaries.
   d. Home medical and nursing care, supplied by local health authorities, or private organizations.

All of the above factors vary widely in different localities and in different business organizations. But given a fixed set of conditions, standards of procedure may be worked out, observance of which will be of the greatest assistance to lay executives, physicians and nurses, and lastly and most important, to the patients themselves.

The procedure described here is the one followed in the Eastern Group of Telephone Companies of the Bell Telephone System, comprising about 65,000 employees. Here the best of conditions obtain under each of the six groups mentioned above. The personnel consists of semi-skilled, skilled and clerical labor, of high intelligence, good social status, and receiving good wages. The conditions under which the employees work are of the very best, the companies realizing that good light and ventilation, rest and retiring rooms, lunch rooms supplying appetizing food, and frequent rest intervals, pay for themselves many times over in a healthy and happy working force. There are no occupational diseases in the telephone industry. Because a large proportion of telephone employees come from the age group that is particularly liable to pulmonary and nervous disorders, they have their share of such ailments. But the incidence is well below that of the general public, and that of most other business organizations. A generous Benefit Fund (maintained by the companies with no contributions from employees) furnishes ample care in accident and sickness, and also provides for pensions, death benefits, etc. Medical departments, with physicians, nurses, excellent quarters and adequate equipment, are maintained. The local facilities for care are extremely good, particularly in New York, where hospital, sanatorium, and dispensary care is readily available, and is of a high degree of excellence.

* Received for publication Feb. 26, 1920.

The three main problems in dealing with industrial tuberculosis in such an organization are:

1. The elimination of tuberculosis from the organization: This can be accomplished by medical examination of all applicants, and periodic re-examinations of employees, and in no other way.

2. The protection of others: The accepted methods for the protection of others against infection are well known, and do not need repetition.

3. The care and disposition of tuberculous employees, the objects in view being:
   a. To secure recovery and return to work,
   b. Failing in that, to rehabilitate as far as possible and secure proper living conditions,
   c. To care for advanced cases.

As in almost every other business organization, medical recommendations for the care of tuberculous employees, involving financial aid and leave of absence, are passed on by lay officers. To them the economic prognosis is of first importance. This, together with length of service and quality of work, determines the amount and duration of assistance. Technical terms are not understood or desired. In the telephone companies the cases are widely scattered, and are seen by different physicians. A simple, practical classification, with an accepted method of disposition for each class, is, therefore, not only desirable but necessary, and some standard recommendation form should be used, giving only the information desired by the laymen. To meet this necessity the following standards of classification and disposition were introduced, and have given good results and satisfaction to all concerned.

Classification of Cases

1. *Very Incipient.* — Slight lesion; no tubercle bacilli ever found in sputum; general condition fair to good; diagnosis confirmed by X-ray. Such very early incipient cases, with proper care, recover in most instances, the employees returning to work within two or three months, often without knowing they have had tuberculosis. Early recognition is most important, as further progress markedly lessens the chances of recovery. In these cases, with their favorable outlook, special assistance is usually justifiable both from a humanitarian as well as from an economic standpoint. Being non-infectious, they may and should be treated at rest homes, not especially intended for or associated with tuberculosis. Where such homes are not available, they should be sent to sanatoria for incipient cases. To secure the best results neither these cases nor those in Group 2, as a general rule, should be allowed to remain at home, under original conditions, even with the best of medical and nursing care. Time is an important element, and the diagnosis of "possible tuberculosis" should be made as speedily as possible, without delays for repeated sputum examinations, prolonged temperature observations, and consultation examinations. True, many of the cases have not tuberculosis at all, but the patients are ill and need care, as shown by loss of weight, elevation of temperature, disturbed digestion and abnormal lung findings.

Of a consecutive group of forty-two such cases, thirty-eight returned to and remained at work, after an average absence of three months. A considerable proportion of these cases are probably not tuberculous; the same is true of ordinary sanatorium figures. Rest-home treatment obviates the stigma of tuberculosis, often unjustified, yet crippling activity throughout life. Sanatorium treatment is the only other resource.

2. *Early Favorable.* — Moderate lesion; tubercle bacilli present now or formerly; condition fair to good. These early favor-

MEDICAL DEPARTMENT

Medical Officer

FORWARDED TO
FOR HIS INFORMATION. THIS COPY FOR HIS FILE. ORIGINAL FORWARDED TO EMPLOYEES' BENEFIT FUND COMMITTEE, ANY RECOMMENDATION FOR "OTHER BENEFITS" FOR DEPENDENTS SHOULD BE ORIGINATED AND FORWARDED AS SOON AS POSSIBLE

CASE OF TUBERCULOSIS
REPORT AND RECOMMENDATION

....19........

TO
FROM
Examination of.. Occupation..
Department........................ Division........................ Business Address..

Amount of Lung Involvement..
.... Cavities ?........................
Stage of Disease 1, 2, 3, 4 ? .... Fever ?........................
Sputum: Pos. / Neg........................191 Prospect of Recovery and Return to Work..
Home Care ....
Family Circumstances ....
Probable Duration of Absence........................ Months until........................19

RECOMMENDATION: (Cross out numbers not used)

AT HOME 1. Employee May Safely Remain at Home Until .... where {he / she} will receive proper medical and nursing care, and all necessary precautions will be observed.
Weekly Cost for Medical Care..

IN INST. 2. Employee Should Enter / Continue at ....
Weekly Cost........................ Extras........................ Railroad........................
....
....

ELSEWHERE 3. ....
Weekly Cost ....

REMARKS: (If Rest Home Case Use Notation No. 2 under "Remarks") ....
....
....
....
....

....M.D.

Approved and Forwarded to Employees' Benefit Fund Committee ........................M.D.
MEDICAL DIRECTOR

Approved and Forwarded to Medical Director ........................M.D.
MEDICAL OFFICER

(FRONT)

INFORMATION FOR PHYSICIANS

In giving the information called for on the face of the report the examining physician is requested to observe the following:

AMOUNT OF LUNG INVOLVEMENT: Information is desired as to what lobes are involved, existence of cavities, if pleurisy is present, etc.

STAGE OF DISEASE: This is to be stated as

1. Very Incipient. (Sputum has never shown tubercle bacilli; general condition excellent; prospect of early return to work good.)
2. Early Favorable. (Sputum has shown tubercle bacilli; general condition good; prospect of recovery and return to work good.)
3. Moderately Advanced. (Sputum as in 2; general condition fair to good; prospect of complete recovery and return to continuous work poor.)
4. Advanced. (Sputum as in 2; general condition poor; fever, etc.; no prospect of return to work.)

In estimating stage of disease, the amount of physical disability, presence of fever, etc., must be considered, as well as extent of lesion.

PROSPECT OF RECOVERY AND RETURN TO WORK: This should be stated as Good — Fair — Bad — None. The question of permanent return to work is important, as the sputum must be negative.

HOME CARE: This should include housing conditions, whether patient has separate room and bed, proper and sufficient food, and if necessary precautions to protect others are being observed.

FAMILY CIRCUMSTANCES: Should be described as Good — Fair — Poor — Very Bad.

DURATION OF ABSENCE: The period of absence in cases in the first and second stages should not exceed three months. It will be extended if necessary. In stage four, six months should be recommended.

RECOMMENDATION: In recommending that a patient remain at home, the physician should make sure that the patient will have good care, proper and sufficient food, continuous medical attention, and that necessary precautions to protect others are observed. He should consider the real interests of the patient and the family, and not be unduly influenced by unwillingness to enter a sanatorium or other institution, from fear of homesickness or other inadequate reason. Cases in an early stage, and with a relatively good prospect of recovery and permanent return to work, should enter sanatoria and not be sent to institutions where they will come in contact with advanced cases. More advanced cases should not be sent to sanatoria. If the home conditions are not satisfactory, and medical care is required, they should enter a tuberculosis hospital.

(BACK)

able cases (with positive sputum) are dangerous to others, and should be treated in special tuberculosis sanatoria. The outlook for recovery and return to work is still quite good, although from six to nine months are usually required. Such cases, to ensure recovery, should be sent to sanatoria for incipient cases only. They should not be sent to general tuberculosis institutions, where the association with advanced cases is depressing and harmful. Some free state or city sanatoria are, therefore, not advantageous, as they receive all groups of cases.

3. *Moderately Advanced.* — Lesion moderate to extensive; there may be continued fever; tubercle bacilli as in Group 2; condition fair to poor. These moderately advanced cases, with proper care and little or no work, sometimes remain in relatively good health for years. But return to work is usually only temporary, is often followed by relapse, and should not be encouraged. Because of the slight chance of complete recovery, such cases should not be sent to expensive sanatoria which are intended for the permanent restoration to health of incipient cases, and where they stand in the way of curable cases. When institution care is indicated, they should be cared for in private, semi-private, or free tuberculosis institutions accepting cases in the more advanced stages. But many may safely remain at home, provided they receive proper care and observe the necessary precautions to protect others, particularly children. A short period of instruction at a sanatorium is often warranted.

4. *Advanced.* — These cases include all that the name implies — patients in whom the disease is progressing to its termination. Such advanced tuberculous patients, with no chance of recovery and return to work, are usually better off at home with their families, if the conditions are satisfactory. Before hurrying them into an institution, an attempt should be made to correct unsatisfactory home conditions, and so make removal unnecessary. Less money is required to furnish satisfactory sleeping conditions, good food and medical care at the home than in an institution. Where unfavorable home conditions make it necessary, however, they should be sent to free, or very moderate priced hospitals, as near their homes as possible. As in Group 3, sanatorium care should not be recommended, an additional reason being that sanatoria are not equipped to furnish the additional nursing and medical care required in such cases.

Recommendation Form: The form used for submitting recommendations for medical care is shown herewith. Instructions for the examining physician are given on the reverse. The examining physician is responsible for the classification of the case and the prognosis. The investigation of home and family conditions is, of course, best made by nurses. The period of absence set should be three months in all cases with a prospect of recovery and return to work. At least six months should be recommended in others.

Progress Reports: Each case should be followed up monthly, and information obtained as to condition.

Return to Work: Even after return to work, cases should be kept under observation, and should be re-examined every two or three months for a year.

Results

No figures can be given as to the total number of cases in each class for any particular period of time, nor as to the results. In the metropolitan area of the New York Telephone Company, 29 per cent. of all cases of pulmonary tuberculosis under observation during 1918 and 1919 have returned to and continued on duty. Eventually, with better facilities for early recognition and prompt institution of treatment,

the proportion of recoveries should reach 50 per cent. During the same time, the proportion of advanced cases fell from 35 per cent. to 10 per cent., the moderately advanced from 40 per cent. to 20 per cent., with corresponding increases in the two early classes. Many moderately advanced and advanced cases have been safely and happily returned to their homes and families from institutions. This alone was well worth accomplishing.

Summary

An attempt has been made to set forth the following:

1. That, where possible, a standard method of procedure should be adopted in caring for cases of tuberculosis in industry.
2. That the procedure should be adapted to the needs of lay executives, and based on economic prognosis.
3. That cases in the earliest stages, including those only suspected of having the disease, should be constantly sought for and at once put under treatment in rest homes, with a view to early and permanent recovery.
4. That such cases should not be stigmatized as having tuberculosis.
5. That many cases, in which the economic prognosis is poor, are cared for better and more cheaply at their homes than in institutions.

ANTHRAX*

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

IN the romance of medicine — tracing the cause of disease and trying to find the means of prevention or a cure when it occurs — anthrax takes a high place. Anthrax is a fatal disease affecting certain animals, especially horses, cattle, sheep and goats, which may be conveyed from them to man. In Great Britain, Australia, and the United States, the disease is comparatively rare, but in uncivilised countries where precautions are not taken to prevent it, as in Russia, Turkey, Persia, India, China, Siberia, and South Africa, it is common, and much infected material is often shipped to British ports.

The following table shows the incidence of anthrax in Great Britain between the years 1909 and 1918.

INCIDENCE OF ANTHRAX[1]

Industry	1909–1913	1914–1918
Wool	165^{26}	242^{31}
Horsehair	34^{5}	20^{6}
Hides and skins	79^{11}	94^{11}
Other industries	10^{3}	18^{3}
Total	288^{45}	374^{51}

[1] The inferior figures refer to cases, the superior figures to deaths.

The essential cause of anthrax is a tiny rod-shaped bacillus which has to be magnified 300 times before it can be properly seen. This bacillus, once it has gained access to the blood, multiplies so rapidly that it chokes the blood vessels. If an animal dead of anthrax is immediately buried without the carcass being opened or the skin removed, no risk to man or other animals is run; but once the blood is allowed to come into contact with air, the bacilli form seeds or spores which are far more difficult to destroy than the bacilli themselves. These spores can remain alive for years, and any fleece, wool, skin or other part of the carcass upon which blood has escaped will contain myriads of them. Fleeces, hides, and skins containing the spores come to this country in a dry condition and when unshipped at the docks or opened in the factories may be the source of dust particles to which spores are attached. This dust may readily come in contact with cuts or scratches — even ones that cannot be seen by the naked eye — on the neck, face, or any part of the body of men handling the hides. The spores may then develop into bacilli and multiply rapidly, giving rise to a sore with a black center surrounded by blebs — the lesion characteristic of the external form of anthrax. Now is the time for treatment and the earlier this is undertaken by recourse to the surgeon's knife or to injection of anti-anthrax serum, so much greater is the chance of recovery. Sometimes the spores, instead of alighting on the skin, may be inhaled into the lungs and penetrate from there to the blood stream giving rise to the form of anthrax known as wool-sorters' disease. The early symptoms in these cases may be mistaken for those of influenza. This form of anthrax is invariably fatal, but fortunately much less common than the external.

This, as briefly as I can put it, is the bald outline of what anthrax is. Yet when I describe to you some of my experiences, you will see the dramatic and wonderful nature of the disease. I sometimes feel that there must be a collective mind in the world of anthrax bacilli, with an instinct

* Lowell Institute Lecture, delivered in Boston, Mass., Dec. 11, 1919. Received for publication Dec. 12, 1919.

for surprising and for getting the better of all man's efforts against them, just as there is an instinct in the fox to be cunning, and in the bee to make honey, or to sting you if you interfere with it. This is, perhaps, putting the matter in a ridiculous way but, nevertheless, anthrax so far has always been the victor. It always makes a frontal attack and is, in this respect, a splendid antagonist, so different from lead poisoning or fibroid phthisis — slinking and slow diseases, taking years to develop and incapacitate. For anthrax, a fortnight is time enough for either cure or kill. And anthrax is no respecter of persons; the very strong and robust succumb as readily as the weak. I remember once, after attending an inquest on a fatal case in a worsted factory, having a sorter pointed out to me as the strongest of the strong, and as having been exposed for nineteen years with impunity to daily risk of infection. A week later I was present at the inquest on his body. And in London I remember attending an inquest on a boy employed in an ironmonger's shop, who had contracted anthrax through wearing the scarf of his brother who worked in a horsehair factory — as his mother related to the coroner. And a week later I attended the inquest on the body of the mother who had nursed her boy.

If one day I say to myself, " How strange it is that anthrax does not seem to occur on the fingers," I am pretty sure to find that the collective mind of anthrax has decreed that the next case shall be on the finger! I am not superstitious — far from it — but coincidence after coincidence of the kind I have related has inspired in me a respect for anthrax which I wish to convey to you and which I ask you to share, while I go on to describe the solution of the problem of anthrax which we think we have reached in England so far as the worsted and woollen trade is concerned.

The actual number of cases of anthrax in man is not large — perhaps one hundred a year, of which twenty to twenty-five prove fatal. But numbers do not count in the matter of seeking to prevent a fatal disease. When you compare the number of deaths annually due to anthrax with the number due to measles, say 30 as against 12,000, it is a matter for surprise that anthrax is so much dreaded and that measles is looked upon as a comparatively trivial complaint. A quarter of a century ago the deaths from hydrophobia annually numbered perhaps two or three, yet no one hesitated in saying that every means must be adopted to eradicate so horrible a disease, and for months the importation of dogs was interdicted and the disease finally stamped out. Medical science will not rest until all that can be done in this direction has been done. And industry will do well to demand that the knowledge so gained is properly applied to assuage the suffering which will otherwise inevitably occur.

Here I would like to pay a tribute to the work done by the Bradford Anthrax Investigation Board, formed in 1905, which is a signal instance of the recognition by enlightened members of a great industry of their duty to combat in every way in their power any menace to life or health inherent in the materials used in the industry in question. When the work of the Bradford board commenced we were extraordinarily ignorant of the classes of wool and hair infected, how largely they were infected, and of how often in a case of anthrax the bacillus would be found in the blood clots or in the wool in which no blood could be detected. It was this board which made the first sustained effort to determine how far it was possible to disinfect worsted and wool by steam or chemical means. Thousands of samples of wool were examined and anthrax found in a surprising number — sometimes where least expected, as in Russian pulled stockings. Without the work of the anthrax investigation board, I should not be here to tell you of

the solution of the problem of anthrax in wool.

Anthrax-infected material is either of high grade or of low grade. Of high grade infected materials, the most important are Cape mohair, Turkey mohair, and alpaca. The low grade infected materials comprise all those from the southern, central, and western areas of Asia with, in addition, inferior qualities of alpaca, and of Cape mohair. These materials are regarded as the most dangerous because it has been found over many years that the persons handling them have suffered most from anthrax. The order in which I should rank them according to danger would be as follows:

East Indian wool and goat hair......	96^{10}
Persian wool....................	62^{14}
Turkey mohair...................	27^{4}
Camel hair......................	10^{6}
Van mohair......................	8^{2}
Cape mohair.....................	5
Alpaca..........................	3
Cow hair........................	2
Australian and New Zealand wools ..	4
Home wools......................	2

The routes by which the wool travels are of importance as showing where disinfecting stations should be located in order to prevent the arrival of infected material in England. Thus, wool from Central Asia may travel south to Karachi and thence to Liverpool, or north to Bokhara, Nijni Novgorod, etc., and thence overland via the Caspian to the Black Sea, or across Russia to the Baltic ports for shipment.

Let us consider for a moment what the processes are through which these infected woollen materials pass when they arrive at the factory. You must remember that even before arrival at the factory some risk of anthrax has been run, first, by the workpeople concerned in transport, and secondly, by buyers and warehousemen in warehouses at the ports where materials are stored. Dust is inseparable from each of the early operations before the materials are washed. Washing, however, is only practised in the case of worsted, the principal object in the cleaning of wool being the removal of the sand, often present to the extent of 30 per cent. of the weight. The first procedure in unpacking consists in breaking the bands of the hydraulically packed bales — a process accompanied by the evolution of dust. Next comes the opening and sorting of the fleeces so as to divide them according to length, quality, and color. They are then blended and the blend fed into a wash bowl. I call your attention especially to the wash bowl used at this point because the suggested method of disinfection depends on the preliminary washing and disinfection by chemical means in a modified apparatus of the same kind. After washing, the wool is dried, is fed into what is called the hopper of the card, and is then passed into a preparing machine where the fibers are separated, one from the other, by steel points and are brought approximately parallel to one another. The fibers are then gathered into the sliver. The sliver in the case of worsted is subsequently combed, the long fibers being separated from the short and rolled into balls of "tops," while the short, called "noils," are collected and subsequently used in the woollen and felt trades. The great fact to remember in these processes is that before washing and carding the coarse dust in the hair is the danger, and in the carding and subsequent processes there is still dust — so fine that you hardly notice it — given off by the separation of one fiber from another. Anthrax spores come off attached to these particles of dust.

For a long time it was thought that the washing process cleaned the wool sufficiently by removing the blood and dirt to which anthrax spores adhere. But so many cases of anthrax arose in the later processes of combing and spinning, it became clear that, while many spores no doubt

were removed in washing, the blood-clots containing them became broken up in the wash bowl and entangled in wool which previously had been free from them, and that free bacilli suspended in the water itself impregnated the wool. The last state, therefore, became worse than the first. In the worsted industry more cases occur, after washing, than before, and in the woollen industry, after carding, than before.

Now, what has been done to prevent anthrax in the factory? For forty years past, preventive attempts have been made by rules and regulations centering in the effort (1) to remove and suppress dust — which is impossible wholly to do — (2) to separate out fallen fleeces, that is, those which look as though the animal had not died a natural death — a matter often impossible to decide — and (3) to warn the workpeople of the importance of early recognition of the disease, and of early treatment — warnings which unfortunately are not always acted upon. Latterly, without any regulations, praiseworthy effort has been made to remove blood clots from the wool, and in certain factories, where specially dangerous materials are handled, to follow up cases of absenteeism in workers by the visit of a medical man, expert in the diagnosis of anthrax, with a view to the earliest possible treatment. I cannot emphasise this last point too much; of the cases seen by the special doctor referred to, 74 per cent. have been mild cases, and only 7.4 per cent. fatal, whereas of the ordinary cases coming to the Bradford Infirmary 50 per cent. only have been mild, and 15 per cent. have proved fatal.

I have no doubt that all these preventive measures have played a part and that if they had not been adopted the number of cases and the fatality from anthrax would have been greater. The following figures of incidence of anthrax, however, in the wool industry for five-year periods show how the measures used have failed even to prevent an increase in the number of cases:

1896 to 1900	1901 to 1905	1906 to 1910	1911 to 1915	1916 to 1920 (4 years)
56^{12}	98^{29}	130^{21}	164^{28}	327^{45}

The inferior figures indicate the number of cases; the superior figures, the number of deaths.

The reason for the increase in the number of cases of anthrax is that the disease is not caused by a known chemical compound or other inanimate substance used in manufacture, but by a living organism accidentally attached to the material handled and giving no evidence of its presence there. The remedies applied so far have all been directed at treating the effect and not the cause. And so long as the cause remains it is potent for mischief, not only in the dust in the factory, but also in the waste waters flowing into the drains or in the waste products sold as fertilizer.

There are only two possible ways of treating the cause and so preventing anthrax. The first is to prevent animals from contracting the disease, and the other is to destroy the germs after the disease has been contracted. Hitherto both have been considered too formidable to attempt. No one could entertain any hope that the nomadic tribes in central Asia or any uncivilised country would take rational steps to stamp out anthrax in animals. So fatuous is the suggestion, I will not waste time in further alluding to it. On the other hand, while the problem of disinfection appals by its magnitude, if practicable, the countries of the world would be prepared to make effort to give it effect for the dangerous classes of wool from central and southern Asia, etc., where alone it would be necessary. Hitherto, except as regards horsehair, no method of disinfection has availed to destroy the bacilli or spores without at the same time destroying the material. Steam under pressure at a temperature of 225°F. is by far the best disin-

fectant. Spores exposed naked to this temperature are killed with certainty in from five to ten minutes, and even if wrapped up in many folds of blankets or in fleeces, the steam will penetrate to them and will cause their destruction in half an hour. Infected horsehair from such countries as China, Russia, and Siberia, although not improved in quality or for manufacturing purposes by the process, can rightly be subjected to steam in order to safeguard the workers. White hair, however, is turned yellow in the process and so is wool, but what prohibits steam in the case of wool is that the fiber loses its strength and elasticity if exposed to it.

Such was the position which faced the anthrax committee appointed in 1913 to revise the woolcombing regulations. They had either to recommend harassing restrictions on the manipulation of wool in the factory without believing that these restrictions would do more than reduce by a very little incidence of anthrax in the workers; or they had to set about trying to find a method of disinfection, up to that time believed to be impracticable. Fortunately, on the committee in question was Dr. Eurich, the bacteriologist of the anthrax investigation board, and the secretary, Mr. G. Elmhirst Duckering, a skilled chemist. They envisaged the problem thus: Our task is first to rid the spores of all their protective clothing in the way of blood and grease, and then to kill them by the disinfectant. There were thus two separate stages in the process.

In the basement of the conditioning house at Bradford, experimental tanks were arranged, specially highly infected blood clots were made, dried, rolled up in wool, and placed in one tank. Here they were raked backwards and forwards, first in cold water, next, as this was not very successful, in warm water, and finally, as experience taught, for twenty minutes in warm water containing some soap solution and a little sodium carbonate. Then, and as part of this process, the wool containing the softened clots was squeezed three times between rollers. The effect of this was to squeeze out nine-tenths of the blood and leave it behind in the tank of warm water and alkali. The wool with very little blood adhering to it was then placed in another bath of warm water containing $2\frac{1}{2}$ per cent. of formaldehyde. Formaldehyde is a powerful disinfectant, and the blood and wool, after being moved about in it for twenty minutes were found to be practically free from all living bacilli and spores. This result naturally was not attained all at once. Some 130 experiments altogether were carried out, and the committee concluded that if the spores were properly freed there could be no doubt of the subsequent destruction of practically all the spores by the $2\frac{1}{2}$ per cent. formaldehyde. I say "practically all," and to make it certain that all should be destroyed they recommended further that the wool should be dried with the formaldehyde still upon it in order that it might go on exerting a disinfecting effect.

The process is simplicity itself, but you will understand that disinfection to be really effective must be most carefully controlled. The first question to consider is where shall the disinfection be done — in the factory or elsewhere? Against disinfection in the factory is, first, the difficulty of ensuring that the process be precisely followed — the breaking up of the blood clots and exposure of the spores, the strength of the disinfecting solution and the rest. A special apparatus would have to be installed, and a very large apparatus, too. But the most powerful argument against disinfection on factory premises is the fact that the bales would all have to be opened before immersion in the bath and none of the people, therefore, who handle the wool prior to disinfection would be protected. The same risk would be run in transport,

on ships, at the docks, and in the warehouses. If not in the factory, where then should disinfection be done? There are only two points at which wool is concentrated — the one at the point of export and the other at the port of arrival. It must, therefore, be disinfected at one or the other of these points.

The advantages of carrying out the disinfection at the two principal ports by which wool enters Great Britain — Liverpool and London — are, first, that we know it would be done efficiently and in two places only. This, however, would only protect the workers in factories in that country, and would not protect those in France, the United States, and other countries to which wool goes. You may say these countries can protect themselves by setting up disinfecting stations of their own. This is true, but cannot a better method be devised because, after all, if disinfection is carried out in home ports all the dangerous processes of opening the bales and repacking and rebaling, which had been already done before export, will have to be repeated. If only the process could be done once for all before the initial packing and baling in the country of export, you would first destroy the spores at an early stage; secondly, remove the danger in transport; thirdly, clean the wool and free it from much of the sand now mixed with it — in short, from the starting-point make it safer and cleaner to handle in every way.

This is what the anthrax committee have recommended, and the way they propose it should be done is by the formation of a disinfection authority appointed by the British government, whose duty it would be to erect the necessary disinfection stations in foreign countries, carry out the disinfection by their own officers, and affix their seal of disinfection to every bale. Each disinfecting station would have a superintendent engineer and also a chemist to see that the solutions were of the proper strength and to test samples of the material as to their freedom from anthrax spores. The general work of the station would be carried out by native labor. The committee definitely recommend establishment of such stations at Karachi and Bombay to deal with East Indian wool; another at Basra in the Persian Gulf, for Persian wool; and a third at Cairo for Egyptian wool. They think also that there must at any rate be one disinfecting station in England for the material which may arrive undisinfected, and that this station should be the first to be erected so as to make a beginning and to gain experience as to the best type of apparatus.

These in brief are the proposals. And how is the cost to be defrayed? Disinfection must be made to pay for itself by a charge on the wool disinfected. The committee estimate that the cost of erection of stations to deal with the eighty million pounds of Asiatic and Egyptian wool will be £250,000. By levying a charge of about 3 halfpence per pound on the wool disinfected, this cost will be covered. In considering this additional charge on the purchase of the wool, users of it must bear in mind the extra charge they now incur because of the risk of anthrax. Thus, annually a commission factory in Bradford has paid over £1,000 for the upkeep of fans and other requirements of the woolcombing regulations and for compensation for illness and death attributable to anthrax. In the same factory the capital cost of the apparatus necessary for prevention of anthrax and dust has been over £1,000 and yet real relief has not been, and is not likely to be, secured.

Let us look forward now to the state of affairs which may exist in the dangerous wool trade, shall I say, five years hence. By that time normal trade will be established on a greater scale than ever with each person trying to effect the greatest

efficiency in his own branch, and, as a result of the war conditions, that part of the world where chance of reform before was most hopeless — Turkey, Asia Minor and Persia — will have been transformed. They will be amenable to British requirements. Stations under the British disinfecting authority will have been established in the Persian Gulf, in Karachi, Bombay and Cairo, and all wool from there will come over, clear of sand and dirt and free from danger. Constantinople will be internationalised, and will have become a clean city where the requirements of the disinfection authorities will be carried out. Russia will be recovering and will have entered into co-operation with us as to disinfection. South Africa will have taken steps, in imitation of Australia and New Zealand, to stamp out anthrax. At home what will be the result ? Bradford and the West Riding, Kidderminster, the Rossendale valley of Lancashire and Kilmarnock will be largely freed from the nightmare of anthrax; the excessively dusty processes in the breaking of the bales and blending will be nearly dust free, and necessity for regulations will have largely ceased to exist. But while those regulations directed against the danger of anthrax may be superfluous, you will readily acknowledge that nothing in them which makes for the greater comfort and well-being of the workers could be withdrawn. Indeed, all look forward to better welfare provision being made not only in factories where dangerous wools are used, but also in all worsted and woollen factories. This is what I believe will be done — welfare arrangements in factories will take the place of restrictions directed against anthrax, the danger of which will be largely a thing of the past.

Anthrax, however, is not limited to wool. Generally speaking, there are as many cases every year among hide and skin workers, horsehair workers, and others as there are among wool workers. No man likes to think that the spores of anthrax lurk in his shaving brush, but it is literally true that spores have been found in shaving brushes during the war and hundreds of thousands of brushes have been destroyed in consequence. The duty of the disinfection authority is, therefore, to rid all animal tissue used industrially of the risk of conveying anthrax infection.

INDUSTRIAL HYGIENE IN THE HIGH SCHOOL OF COMMERCE *

MICHAEL LEVINE

Department of Biology of the High School of Commerce, New York City

A GREAT vocational high school like the High School of Commerce with an enrolment of 3750 boys has a clear mandate from the community. The return of industry to its normal condition lays a burden upon such an institution to do its share in solving those problems in industrial organization upon which scores of social agencies are now engaged. The demand for men and women who are to direct the industrial workers and to administer to the needs that arise in the stress of industrial occupations, has already been felt by our leading universities. The establishment of higher schools for the study of hygiene is, however, not entirely adequate and does not directly affect the industrial worker. It is a well recognized fact that the industrial world is supplied annually with a host of immature and sub-normal recruits whose improvement must come, to an extent at least, from activities within their own ranks.

This need of preparing the workers for better living has found expression in some states by the formulation of laws for direct instruction in hygiene. The Welsh-Slatter Law, a measure passed by the New York legislature in 1917, for instance, makes the study of hygiene a required subject in all high schools of the state. The law fills a long felt want, but it does not prescribe the content of the course, and the teachers have, therefore, been compelled to develop for themselves the phases of the work which ought to be stressed.

In the High School of Commerce it has been our purpose to develop the course so that the study of industrial hygiene should rest as a cap stone on our work. The work of the four years is, therefore, divided in general into four groups:

1. Personal hygiene.
2. Hygiene of the home.
3. Hygiene of the community.
4. Hygiene of industry.

The work in personal hygiene in the first year is merely an elaboration of the work done in physiology and general biology, with special emphasis on the phase of life which the pupils are experiencing. Such topics as feeding, digestion, circulation, respiration, ventilation, excretion, bathing, clothing, personal cleanliness, and appearances, are dealt with. The subject of hy-

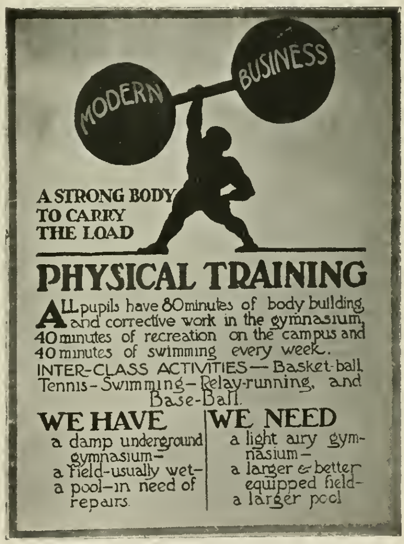

FIG. 1. — Photograph of a poster showing what the High School of Commerce is doing for its pupils through its physical training work.

* Received for publication March 31, 1920.

giene of the home and community, assigned to students in the second and third years of the course, deals mainly with the broader questions of health and disease which are truly community problems. This is associated with studies of bacteria and other organisms whose activities are utilized by man in the production of materials necessary to him.

Thus far, the work as it is here briefly outlined probably corresponds in the main to the courses given in other schools. The temptation to devote the fourth year to review exercises and to mere physical examinations is undoubtedly great. Until recently the application of general principles in the course in the high schools was, as far as we know, never satisfactorily made, and consequently hygiene in the fourth year was generally characterized as weak and inefficient. In the High School of Commerce the effort to make this subject in the last year of school of vital and practical importance has led us to develop the course in industrial hygiene. Now we find that the three years' work in personal hygiene and community hygiene has been vitalized. It has become real and practical.

Fig. 2. — Photograph of a poster showing what the High School of Commerce is doing in the pupils' lunch room.

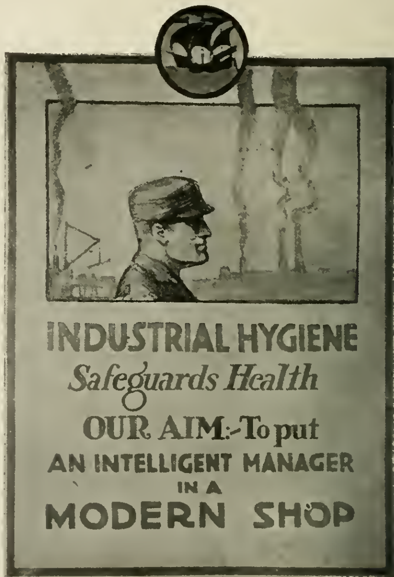

Fig. 3. — Photograph of a poster made by the Commerce Art Department for a parents' meeting showing what the High School of Commerce is trying to do for the New York City boy through its work in industrial hygiene.

The four years' course, including as it does the study of industrial hygiene in the fourth year, really functions much better than a prolonged discussion of personal and community hygiene.

This does not mean that in the High School of Commerce we do not realize that personal hygiene is of great importance. At the same time, we feel that it leads naturally to the broader problem of production and, therefore, it is this aspect we have endeavored to stress. Thus our aims are fourfold. We are endeavoring:

1. To inculcate a hygienic sense of cleanliness, neatness and general pride.

2. To acquaint the student with the various industries and their concomitant dangers to health and life.

3. To study the means and devices for protection of the worker against industrial hazard.

4. To give the pupil an interest in the general problems of living, which tend to establish better relations from a hygienic point of view between the employer and the employee.

We are making an effort to send to the industrial world a young man who is not only interested in and understands his business relations, but also one who understands the health forces which enable him to realize that the body is a machine worthy of the care and the consideration that he gives to the machines which he is employed to direct. We are trying to fit the boy physically for his career and to teach him the principles of right living. With these aims in view the work in industrial hygiene is presented in the High School of Commerce briefly as follows: *

I. The social forces at work which make for the health of the citizen are first studied. Under this heading are included the organization and the activities of the health department, department of charities, state department of health, public health service, and the industrial commissions. There organizations are treated briefly, emphasis being placed especially upon the relation of these organizations to the industrial world.

II. This is followed by a study of the chief industries of the community and the mortality frequency in each. Statistics on the chief causes of death, compiled by the Metropolitan Life Insurance Company, the New York Life Insurance Company, and other agencies, are carefully compared. Occupational diseases are studied through the project method. Pupils report to the class on the working conditions in the various trades in which they are interested or in which their parents are engaged. Remedies are devised and suggested. Visits to factories and shops are encouraged, and reports based on these visits are heard. The Compensation Law is read and its effect upon the worker and upon the employer is discussed. Industrial fatigue and its relation to production, efficiency, disease, and industrial accidents, are studied through reports made by pupils. Finally, social welfare work, its relation to the employer and employee, its dangers and its benefits as carried on by the du Pont, Ford, and other industrial organizations are made the basis of discussion. Industrial and health insurance in America are compared with conditions that pertain in foreign countries.

In this way the course in industrial hygiene in the High School of Commerce comes as a fitting climax, and gives the boys who are about to graduate a vital appreciation of those hygienic principles which are being applied in the industrial life of the community of which they will be a vital part.

To Dr. Arthur M. Wolfson, Principal of the High School of Commerce, I wish to express my sincere thanks for many suggestions and the encouragement given me during the progress of this work.

* A more detailed outline of this course has been published by the author in the Bulletin of High Points (a monthly publication issued by the Board of Education of N.Y.C.), 1919, 1, 23–24.

THE HOUSING PROBLEM IN GREAT BRITAIN AND IRELAND *

JOHN S. HODGSON

Secretary of Housing Board, Massachusetts Department of Public Health

NO study of this subject would be other than misleading in the absence of due regard to certain principles which have long controlled English domestic policies. Briefly stated, there is an ingrained disposition to avoid governmental intervention in problems for which private initiative can furnish a solution. If this has sometimes been carried to the verge of *laissez faire*, the test of results is held largely to have justified reliance upon a preference admirably crystallized in the writings and speeches of Edmund Burke. Thus, in the field now to be reviewed, private enterprise had been responsible for 95 per cent. of all houses built before the war. Then, again, the commercial instincts of the English people have inevitably favored individualism as opposed to collectivism, with the result that even the best-intentioned efforts to secure the advantages derivable from centralized activity have been met with suspicion, if not with organized hostility.

These characteristics have found a wide field for their display in various phases of local government. The operation of the highly beneficial Poor Law Act of 1834, substituting for the haphazard and vicious methods of localized poor relief a system of grouped units, administered on accepted principles under the control of a central authority, evoked a degree of opposition difficult of comprehension by later generations. Offensive nicknames were applied to the three commissioners appointed under the act, and riots followed the circulation of stories that poisoned bread was being distributed by the relieving officers as a ready means of killing off paupers. Within the writer's recollection, the same repugnance to centralized control was manifested when, under the Public Health Acts of 1872 and 1875, extensive powers in regard to local expenditure and administration were conferred upon the Local Government Board, the creation of which, under the earlier of these acts, was no more than a development of the Poor Law Board. Yet it may be confidently asserted that any proposal to revert, in either case, to the old order would be vehemently opposed.

Early Conditions and Legislation

These acts are cited, not merely on account of their intrinsic importance but because they were largely the result of conditions inherent in the English factory system. A price had to be paid for the country's pre-eminence as "the workshop of the world," some of it at the time and some of it as an unwelcome legacy to succeeding generations. Under the impetus of philanthropic foresight, much ameliorative legislation for factory workers was enacted between 1819 and 1851, this including Lord Shaftesbury's Ten Hours Act of 1847, but the equally important factor of housing received scant attention in an era, the housing horrors of which were depicted by Disraeli in his early novels, *Sybil* and *Coningsby*. Even when Parliament turned aside from remedying factory conditions, it was the common lodging house, not the home of the worker as now understood, that secured its attention. Lord Shaftesbury's Common Lodging House Act, giving increased powers of inspection, was passed in 1851 and in the same year that great philanthropist carried a measure authorizing certain local authorities to erect public

* Received for publication Feb. 27, 1920.

lodging houses out of local revenues. A considerable advance in this direction was made in 1866 in the adoption of the principle of granting loans from the national exchequer to enable municipal authorities to carry out approved schemes of lodging-house construction.

In the Torrens Act of 1868 are found the germs of the well-known English acts of 1890 and 1909, so frequently cited by American municipal reformers. It was soon found, however, that the limited powers conferred were incapable of dealing with the "unwelcome legacy" already referred to. What came to be known as the Manchester School of Economic Thought, from its intimate association with the tenets of Cobden and Bright, had left its mark in large working-class areas, chiefly covered by what Mr. John Burns many years later aptly described as "brick boxes with slate lids." Not only were these dwellings deficient in what are now regarded as rudimentary essentials of construction and accommodation, but they were usually crowded too closely together and their sanitary provisions were too often dominated by the prevailing craze for cheapness. The persistence of these features can be realized adequately only by those who, as is the case with the writer, have been called upon to amend sanitary conditions of which they formed a part.

The Birmingham Clearance, Etc.

As a further effort, the Artisans' Dwellings Act of 1875 empowered local authorities to acquire property by compulsory purchase in order to deal with it as an "insanitary area," due provision being made for the rehousing of dispossessed tenants. It was in Birmingham, under the epoch-making mayoralty of Mr. Joseph Chamberlain, that the first application of these enhanced powers was effected. Under his guidance, the central area of the city was practically rebuilt after the removal of existing slums, and this was followed by the adoption of building ordinances going far beyond anything ever previously attempted in practice. In this way, the city was left in a condition enabling future operations to be carried on under the less expensive sections of the acts of 1890 and 1909, and thus became a pioneer in really economical administration in an apparently hopeless field.

Experience gained in the working of the Act of 1875 showed the need of amendment in the important domain of compensation for condemned property. "It was found that owners bought out under our improvement schemes frequently benefited from their own misdeeds, because arbitrators assessed the value of property simply according to rental and without reference to its sanitary condition. Accordingly, the amending acts provide that if the house is proved to have been at the date of the official representation a nuisance, then the arbiter shall fix what the value of the house would be with the nuisance abated, and shall deduct therefrom the probable cost of abating the nuisance." Besides this an impetus was given to the removal of displaced tenants to outside locations in preference to rehousing them in or near the former slum district, the earlier restriction in regard to rehousing being removed by amending the acts of 1879 and 1882.

The Housing of the Working Classes Act, 1890, crystallized the experience gained in the working of earlier legislation and practically embodied all that had been done by Parliament since 1851. The essential features of its three leading parts are as follows: *Part I*, dealing with unhealthy areas, authorizes schemes by local authorities subject to governmental confirmation, the provision of dwelling accommodation for families displaced by such schemes, and the proceedings entailed by the acquisition of land and buildings for the purposes of the act. *Part II* covers the procedure involved

in dealing with unhealthy dwellings. Its provisions embrace orders for compulsory closing and demolition, schemes for reconstruction, settlement of compensation, the financing of loans, and special provisions for London. *Part III* confers upon local authorities powers in regard to working-class lodging houses, with special provisions applying to loans to, and powers of, companies and societies.

The Housing and Town Planning Act, 1909, besides simplifying administration and procedure, extended the powers of all authorities and increased the supervisory functions of the Local Government Board, especially as a tribunal of appeal. Town planning received greater attention than in the earlier act. The appointment of medical officers of health by counties, as distinguished from cities, etc., was made obligatory, and various changes were made in the laws affecting the liability of property owners. The act did little, however, to meet the situation as far as the supply of new houses is concerned. It has been freely charged that this weak point in the act has contributed in no small degree to the existing rural house famine.

What Liverpool Has Done

It is impossible, within present limits, to enter upon any detailed discussion of operations under these far-reaching enactments. Nor must it be forgotten that many cities had taken effective steps, under earlier legislation, to remedy many of the more glaring defects resulting from chaotic planning, piecemeal sanitation, and short-sighted economy in civic inception and administration. Among the larger cities, Liverpool is entitled to a high place in the improvement of conditions so wretched as to be responsible for the Liverpool Sanitary Amendment Act of 1864. At that date, no fewer than 30,000 people were living in cellars and there were 22,000 insanitary "court" houses in the city — the homes of one-fifth of the population at that time. These conditions are depicted as follows in the City Housing Committee's Report for 1913:

> It cannot too often be recalled to mind that the whole of these court houses were back-to-back and side-to-side, and so situated that as many as six were built on each side of a narrow strip of land, 9 to 15 feet wide, closed up at each end with high buildings and approached through a long, narrow tunnel, thus forming courts into which the sun could not penetrate and in which the air could not circulate. In each of these courts, there lived from seventy-five to one hundred people. The houses were without closet accommodation, save as to two conveniences situated at the top of each court in full view of the inhabitants, and having one stand-pipe for the supply of water common to all the inhabitants.

Some of these structures, amended, of course, as regards sanitary provisions and living conditions, still remain, but each year sees their number reduced and their places taken by improved dwellings. In the twelve years ending with 1913, 6000 houses rented at or below \$1.70 per week were built, including 2041 dwellings of two, three, and four rooms erected by the housing committee. In 1913, this committee had under its control 2747 buildings, of which 2734 were used as dwellings with an aggregate population of 10,223. The initial general death rate in the affected areas, ranging from 40 to 60 per thousand per annum, has fallen by more than one-half, while the average annual death rate from tuberculosis has dropped from 4 to 1.9 per thousand. It must be remembered that in Liverpool, as elsewhere, "the poverty and unsatisfactory habits of the tenants" were contributory factors to death rates of which it is scarcely possible to read without a shudder.

At the end of 1913, Liverpool had expended \$5,660,000 * under the powers of

* Throughout this article, money conversions are based on par value: £1 = \$4.87.

the Act of 1864, and the work is still going on.

Changing Conditions

The case of Liverpool, while not standing alone, is of interest as demonstrating the failure, in a particular instance, of purely private enterprise to prevent the growth of conditions inimical not only to personal well-being but to the economic standing of the city and to the continued effectiveness of the nation. Goldsmith's lines,

> Ill fares the land, to hastening ills a prey,
> Where wealth accumulates and men decay,

though written with particular reference to rural conditions, apply with full force to such urban centers as those of which Liverpool is a type.

Allowance must be made, in any review of this failure, for the difference between social conditions in 1864 and those of more than half a century later. Increased wages and a rising standard of working-class living would doubtless have lessened the earlier demand for dwellings in which lowness of rent was the chief consideration, but the persistently large proportion of low-priced accommodation in Liverpool stands out even yet as an appealing feature. Quoting from the 1916 report of the City's Housing Committee, there were in that year 152,477 dwelling houses, of which 135,317 (88 per cent.) were let at rentals not exceeding $127 per annum, and of these "113,127 were assessed at £13 and under." Adding to this last figure 15 per cent. as the probable difference between assessed annual value and rental, the rentals of these 113,127 dwelling houses (74 per cent. of the city's total) do not exceed $1.40 per week. It is significant that in the five years, 1912–1916, all the houses erected under a rental of $1.70 per week were provided by the city. That is to say, private enterprise had practically ceased to furnish working-class dwellings.

The experience of Liverpool in this respect is so well recognized as typical that housing reformers, bent upon remedying conditions during and since the war, have been compelled to turn their attention to the causes leading up to this increased dependence upon civic effort in a field once satisfactorily supplied by the enterprise of the speculative builder. Thus, in the presidential address of Mr. W. H. Bradwell, delivered before the Auctioneers' and Estate Agents' Institute, November 10, 1916, figures relating to seventy of the larger cities and towns (including London) were given. The population of the areas concerned is upwards of 13,000,000, representing 30 per cent. of the total population of the United Kingdom. In the five years, 1906–1910, 169,996 houses were built in these areas as compared with only 87,654 in the succeeding five years, these figures indicating a falling off of 48 per cent. during the second period.

The People's Budget

As regards the causes of this serious decrease in building, it is widely and authoritatively asserted that the Finance Act of 1909, often referred to as the Lloyd George Budget, is largely responsible in having frightened those who formerly made it their business to erect and sell houses. The new undeveloped land tax, designed to force the creation of buildings, not only failed to achieve that result but actually led to a loss of net revenue. Not only this, but instances of legalized hardship soon became known. Among these is the Lumsden case, in which a builder erected a house and sold it at a profit. He was charged "increment duty" on the transaction, although paying income tax on his trade profits in the regular course. In another case, 832 working-men bought small allotments to work as gardens and expended about $97,000 in fitting the land for that

purpose. Every one of them was assessed for "undeveloped land duty."

The conditions thus established, together with reasoned apprehensions for the future, were tersely summarized as follows, in July, 1918, in the report of an important housing conference convened by the Surveyors' Institution:

> Part I of the Finance Act has from the first exercised a prejudicial effect on housing, owing not only to the amount of the tax imposed upon the industry but also to the feeling of insecurity and alarm aroused by a measure which its supporters threatened to be merely the forerunner of still more advanced legislation. Whether there was good ground or not for these fears is entirely beside the mark, since the atmosphere of uncertainty was in fact created, causing investors and capitalists to fight shy of house property as an investment and influencing mortgagees to review their security and, in many instances, to revise their terms.

Some color is given these allegations of budget responsibility by figures taken from the annual reports of the inland revenue commissioners. These show that in the nine years immediately preceding (1900 to 1908, inclusive) there was an average annual increase in Great Britain of 85,722 houses of less than $97 annual value, while in the three following years this average fell to 59,332. As recently as December 28, 1919, Mr. J. A. Marriott, member of Parliament, stated that "the one real chance of getting houses was to restore confidence to private enterprise," and blamed the government for the present tendency of its housing legislation.

Governmental Action Since 1916

These considerations have much more than an academic or polemic value for those who may desire to avoid the pitfalls of legislation on false lines. English experience possesses in this respect a special value for a country whose laws are moulded on the precedents of the older nation and whose sentiments naturally flow along the same channels. It will be profitable, therefore, to review the confronting conditions and to trace the somewhat chequered history of the schemes devised during the last three years.

A statement issued by the Ministry of Reconstruction in 1918 placed the housing shortage in England and Wales alone at between 300,000 and 400,000, irrespective of any further deficiency which would accrue from the closing of slum property.* The census of 1911 showed that no less than one-tenth of the population was living under overcrowded conditions and a large number of the inhabited houses, both in town and country, were dilapidated or insanitary and in many cases also dark and damp. Many houses, in fact, "were not reasonably fit for human beings to dwell in." Of one city alone, it had been officially reported that "there are probably between 40,000 and 50,000 back-to-back houses, a large number of which are in courtyards, or in short terraces shut in behind houses which face the street." In regard to villages, one report had stated that "there is in many villages a clamant need for new and better dwellings and, after these have been erected, for the closure and demolition of many of the old ones. Certain villages have suffered evident demoralization as a result of the slow deterioration of the housing conditions of the people." A Royal Commission appointed in 1917 specifically drew attention to the fact of insufficient and bad housing being a cause of industrial unrest in seven out of the eight districts into which Great Britain was divided for separate investigation, and much further testimony of this character could be cited.

In addition to the number required in England and Wales, it was estimated by a Royal Commission in 1916 that 121,000

* This number, as stated by Lord Astor, Parliamentary Secretary to the Ministry of Health, January 8, 1920, has now been increased to 800,000 as the result of a review of the situation.

houses were needed in Scotland to remove overcrowding, apart from any provision to meet the natural increase, and it may be conservatively stated that the present need of working-class houses in Great Britain (i. e., exclusive of Ireland) is little short of a million dwellings, taking Lord Astor's statement into account.

Ireland is a distinct and, in some respects, less onerous future problem. It is true that Dublin, the capital city, offers a task at least as difficult as any to be found in the United Kingdom, for "16,500 new houses are urgently required and 13,000 existing dwellings call for radical and immediate improvement" at an estimated expenditure of $42,000,000. On the other hand, the needs of rural districts are being met by special legislation, under which nearly 50,000 laborers' cottages have already been provided from public funds. Since November, 1906, loans for this purpose have been advanced to Irish local authorities at 3¼ per cent. per annum, this covering interest and repayment of principal for a term of sixty-eight and one-half years. The state bears 36 per cent. of this charge, leaving 64 per cent. to be borne by the local authority as the ultimate owner. These substantially built four-room cottages, some with half an acre, the remainder with an acre of land attached, are let at an average rental of 30 cents per week — about one-third of the economic rent — the tenant paying, in addition, 6 to 8 cents per week for "rates" (local taxes). Up to November 30, 1915, loans amounting to $43,-382,000 had been sanctioned.

British Taxation Methods

A full realization of the ascertained conditions led the Local Government Board for England and Wales to decide, in July, 1917, that substantial financial assistance should be given from national sources to local authorities prepared to carry through without delay, at the conclusion of the war, working-class housing programs duly approved by the board. In order to make the financial proposals intelligible to American readers, it is necessary to set forth some fundamental distinctions between American and British methods of assessment and collection of local levies, known as "rates" to distinguish them from national "taxes." In America, the assessment is upon the nearest possible approximation to the fee simple — practically the amount for which the affected property would sell in the market — and all tax burdens are borne directly by the owner, whose obligation is not affected by the premises being occupied or vacant. In Great Britain, the assessment is upon the "rateable value," which for present purposes may be taken as 85 per cent. of the annual rental. As these local rates are borne by the tenant, it will be seen that nothing is collectable from vacant premises. An exception to this is found in houses of low rental, for which, whether continuously occupied or not, the owner pays the rates, subject to a rebate in consideration of his so doing, the object being to avoid the trouble and uncertainty of collecting from a floating population. It should be noted, in passing, that there is a growing sentiment against a system which, whatever its convenience, detracts from the sense of personal interest and responsibility inherent in the general British practice, by depriving the tenant of any tangible financial concern in the administration of the area in which he lives. While the effect of the "compounding" system is as I have stated, it is equally true that the evil is not capable of easy remedy under the conditions applying to this class of property.

It will now be understood that, instead of applying the American unit of so much per thousand dollars of value, an Englishman speaks of local assessments in terms of "a penny in the pound" (0.417 per cent.) of annual realized value. Computations based

by the writer upon the average rates for 1905–1906, in England and Wales and Massachusetts respectively, showed that each additional penny levied under the English system would raise the Massachusetts tax rate by 26 cents. That is to say, the 1905–1906 average rate of $17.25 per thousand would become $17.51.

The Program of 1917–1918

With these data in mind, it will be less difficult to appreciate the terms of the English government's initial and subsequent proposals. These were foreshadowed in a circular addressed to the local governing bodies of England and Wales on July 28, 1917 by Mr. Hayes Fisher, then president of the Local Government Board. In a further circular, dated March 18, 1918, the principles on which government aid for housing would be afforded were set forth at length. These placed the initial financial burden, in its entirety, upon the local authorities, the government's contribution taking the form of a guarantee applying to a certain percentage of the ascertained annual loss. To that end, the local authority would raise a loan in the customary manner, the eventual sanction of such loan following the usual local inquiry by an official of the Local Government Board. The loan was designed to cover an initial emergency period of not less than seven years,* the necessary state assistance being given not as a subsidy toward the expenditure, but "in the form of a grant of a percentage of the loan charges sufficient to relieve the authority of 75 per cent. of the established annual deficit." That is to say, the prospective inability to collect an economic rent was clearly recognized and the contemplated action of the state left only 25 per cent. of the resulting deficit to be borne by the local authority.

* The *entire* loan period would vary from eighty years for land purchase to sixty years for substantial buildings. For streets and sewers the usual periods are twenty and thirty years respectively.

It should be noted that houses built by private enterprise during the prospective emergency period would face the added competition of the subsidized schemes. A concession was made in favor of public utility societies whose profits were restricted to 5 per cent., by including them in the same category as local authorities as regards the state's 75 per cent. contribution.

The adoption of seven years as the initial "emergency period" was intended to allow sufficient time for prices and economic conditions generally to become stabilized after the war. At the end of the period, 75 per cent. of the excess (if any) of the amount of the loans outstanding over the then ascertained value of the property would be assumed by the state. In the case of loans directly financed by the state, this could be done by writing off the necessary portion of the outstanding liability; in other cases the state would undertake the appropriate share of responsibility for future charges.

Under the 75 per cent. provision it was originally intended that the state's contribution toward the annual deficit should be three times the amount of the call upon local revenues, but later concessions to local representations increased the state's obligation. It was estimated in a concrete case, under the original terms, that a local burden of 5 pence (say 10 cents) in the pound ($4.87) would have to be borne by the rural district concerned and that even a government contribution at the rate of 90 per cent. would leave the district saddled with a housing rate of 2 pence in the pound, although there was a discretionary limitation of the burden to the proceeds of a penny rate levied upon the chargeable area. Applying the figures of this rural district case to the comparison already made between British and Massachusetts local taxation levies, this would involve a total additional

tax of $1.08 upon each $1000 of the normal Massachusetts assessment.

Some Disturbing Factors

What can best be described as "the fly in the ointment" is found in the conditions imposed upon local authorities in regard to structural provisions. The terms of government assistance contemplated what many regard as the extravagant requirement of single self-contained houses, not exceeding twelve per acre in urban and eight in agricultural districts, and the model plans and regulations called for a much greater outlay per dwelling than had ever previously been regarded as necessary or desirable. These conditions are probably responsible, in the main, for the discouraging response of local authorities to date. So far from having secured the building of the first 100,000 houses within a year from the adoption of the scheme, there has been a distinct reluctance among local authorities to avail themselves of its provisions. Official figures, referring to construction bids examined and approved at the Ministry of Health, show that up to October 31, 1919, a total of 7,121 proposed houses had thus been dealt with. The average amount of these bids was $3,497 per dwelling, and even this did not include land, roads and sewers.*

It is obvious that such figures are wholly incompatible with the ideal of economic rent.† As concrete examples of these conditions, the writer may cite two representative cases coming under his notice last summer. In one of these the financial estimate for 10,000 houses, planned for one of the largest provincial cities, was based upon an excess of 50 per cent. over pre-war building costs, with collectable rentals of 100 per cent. over pre-war rates. Notwithstanding these favorable assumptions, it was computed that the state, apart from the local authority, would be called upon for an annual subvention of $1,070,000 during the initial seven-year term. This represents an annual contribution, from national funds alone, of $107 per house per annum and takes no account of the capital sum required for the "writing down" process. In the other case it was officially estimated that 800 houses, costing $4,383 each, would entail an annual financing charge of $411.53 per house, as against an available rental of $158.28, leaving $243.25 as the annual loss per house to be met from public funds, local and national. In other words, the collectable rental would amount to less than 40 per cent. of the annual charges.

The Housing Act of 1919

Considerations of this kind doubtless led to the inception of the new housing bill introduced by Dr. Addison, President of the Ministry of Health, in December, 1919. This department, created by an act of June 3, 1919, takes the place of the Local Government Board for England and Wales and exercises wider functions than those of the earlier body. Its title is significant of the increased importance attached to health problems, as distinguished from poor-law administration and similar needs, and nothing more clearly shows the advance in public opinion, during the last half century, than the unanimity with which these enlarged powers have been recognized as essential.

Chief among the provisions of the new housing act is the power conferred upon the department to make grants to persons or bodies building houses for the working

* It was announced by the Director General of National Housing, speaking in London on January 8, 1920, that 20,000 houses were actually in course of construction.

† There has been for some time a stronger governmental tendency toward the attainment of this ideal after the emergency period. Dr. Addison, Minister of Health, stated on January 9, 1920, that local authorities had been recommended to charge an economic rent for their houses, after writing off one-third of the cost as extra cost due to the war.

classes, to an aggregate amount not exceeding $73,000,000. This is based upon the payment of a subsidy of $730 per house completed within fifteen months after the passing of the act, which also contemplates the issue, by local authorities, of bonds for financing building schemes. There are, in addition, far-reaching provisions in regard to the closing of slums, and other local powers. The aim of the local financial clauses is to relieve the state, in a critical period, from pressure in the raising of funds while leaving the government's control over construction and administration intact. Among other noteworthy features in this respect, funds can be made available for converting houses into flats, and building operations which interfere with the provision of dwelling houses can be prohibited. The tendency toward a relaxation of needlessly drastic local ordinances — a point to which much attention had been given for some years before the war—is exemplified in the exemption from their operation of houses complying with the conditions laid down in the act itself.

Awaiting spring for its fruition, it seems unnecessary to indulge in speculations as to the results to be expected from an act based upon much tentative work and which has given rise to recrimination unusual in English political life. The operation of the new proposals will be of interest to many beyond the limits of the United Kingdom, not only on account of the magnitude of a task too long delayed and the exceptional financial methods entailed, but also because of the apparent desire to embark upon experiments in types and materials. Even wooden houses are seriously proposed, and the mounting cost of construction, revealed to some extent by figures quoted in the present contribution, may be expected to facilitate inroads upon methods sometimes regarded as akin to the legislative products of the Medes and the Persians.

SUPPLEMENTARY NOTE

Developments during the last three months confirm the tendency toward excessive cost of building and the difficulty of reconciling this factor with the desired approach to an economic rent. Contract amounts for building alone frequently range from $4500 to $5000 per dwelling, to which must be added the cost of land, sewers, lay-out, etc. There are many indications of dissatisfaction with the share attributed to labor union restrictions in this result. The bonus scheme mentioned in the present article was not favorably received, the governmental subsidy of $730 per dwelling erected by private builders being regarded as inadequate — a feeling which appears to have been justified, judging from the increase to $1200 announced by the Ministry of Health on May 12, 1920. The scheme of local bond issues for financing housing operations has been vigorously pushed in some localities, three cities announcing an aggregate of $5,500,000 thus raised. In another city, weekly payments toward the purchase of these bonds are being received from workpeople by employers and works committees, and still other cities have inaugurated school savings associations to the same end.

An apparently reactionary outcome of the desire for economy is disclosed in a recent decision of the Ministry of Health, refusing sanction to loans for houses to be erected under the "twelve per acre" rule, in which the ceilings of habitable rooms exceed 8 feet in height. It is being urged by local authorities that this attitude imposes difficulties upon them in enforcing their own by-laws calling for a height of 8 feet 6 inches, but the Ministry has thus far shown no signs of yielding. On the other hand, a bone of contention has been removed by the abandonment of the Lloyd George Budget land taxes referred to in this article. The step thus taken in this year's budget appears to have been as unexpected as it is welcome to land and building interests.

Notwithstanding these and other obstacles, the latest official returns show that schemes for 184,173 houses have been approved by the Ministry of Health, which reports also that actual building has started on 13,355 houses. The Ministry has had to bring pressure to bear, in some cases, upon local authorities lagging behind in the prosecution of this necessary work. The ultimate high cost per dwelling and the difficulty of securing labor and materials are the causes assigned, but progress is being made and the prospects for next year's operations may be regarded as satisfactory. — *J. S. H. June 12, 1920.*

PHTHISIS AND OCCUPATION *

SIR THOMAS OLIVER, M.A., M.D.

Professor of Practice of Medicine, University of Durham and College of Medicine, Newcastle; Consulting Physician, Royal Victoria Infirmary, Newcastle-upon-Tyne

FOR more than two centuries it has been known that certain trades are attended by a higher mortality from lung diseases than others, and in general terms the higher mortality occurs in those industries in which large quantities of dust are generated. Before British coal mines were ventilated by the two-shaft system in use today, viz., a down and an up-draught shaft, whereby healthy atmospheric air is carried into the mine, is driven and directed through it by fans and doors, and the foul air forced to escape by the up-shaft, coal mining was a deleterious occupation; it was attended by a high incidence of pulmonary disease, which in our day has undergone considerable diminution. In the Infirmary we seldom meet with cases of pulmonary anthracosis as was frequently the case forty years ago. This happy condition of things is largely the result of the introduction into the mines of fresh atmospheric air.

Nor do we today find stone-masons' phthisis as prevalent as it used to be. Three decades ago, phthisis was extremely prevalent among the lead miners in the remote dales of the County of Durham; but this was largely the consequence of neglected colds caught by the men coming out of the mine, heated and tired after a long day's work and then being obliged, owing to the scarcity of houses, to walk several miles home across cold wind-swept moors; it was, too, the result of the housing of men in barracks close to the mine. These barracks were overcrowded during five days in the week, the sleeping rooms were practically always occupied by relays of men and were never ventilated, the beds were so close to each other that there was scarcely room to walk between them, and sufferers from bronchial and pulmonary affections expectorated upon the floor. Among these men, pulmonary tuberculosis was less the result of occupation than a consequence of infection and of neglected pulmonary catarrh. Similarly, in the manufacture of pottery, owing to absence of down-draught for the removal during brushing-off of the flint dust in which the ware had been fired, potters suffered in large numbers from a malady of the lungs known as "potters' rot," but here again, since the introduction of means for the removal of the dust, ware cleaning has ceased to be the dangerous occupation it formerly was. File cutters in Sheffield formerly showed a high death rate from phthisis. This was not entirely the result of dust but was due in a measure to the close and ill-ventilated state of the rooms in which the work was carried on, and to the possibility of infection. Steel grinders too suffered in large numbers from the disease, known in this case as steel grinders' phthisis.

The discovery of the tubercle bacillus has been utilized to indicate that there is a unity underlying pulmonary consumption, and that it is the part played by this organism which determines both the nature of the malady and the longevity of the patient. Small wonder, therefore, if the tubercle bacillus is regarded as the specific and causative agent, that doubt should be raised as to occupation being a cause of phthisis among workmen. There is a feel-

* Address delivered to the local branch of the British Medical Association, Jan. 16, 1920. Received for publication March 16, 1920.

ing among some physicians that occupation cannot give rise to such a specific disease as pulmonary consumption and that when consumption appears in workpeople it is because occupation has simply activated tuberculous lesions which have been lying latent since childhood. On the other hand, it is common knowledge that since the introduction of better ventilation into factories the mortality rates from pulmonary tuberculosis have considerably diminished. Other factors may possibly have been in operation, such as better housing and reduced drinking of alcohol. The question, therefore, arises: Is pulmonary phthisis in its earliest inception always tuberculous? Is dust of no importance, or alternating exposure to heat and cold, and does injury to the chest wall never play a part in leading to tuberculosis? What is to be said too of those occupations which oblige the worker to remain in a cramped position whereby the respiratory movements of the chest become limited, thus interfering with respiration and reducing the local resistance to disease?

Clinical experience and statistics alike show that there are cases of pulmonary consumption which are due to occupation and are a consequence of direct injury to the lungs by inhalation of dust — inorganic and organic — the course of which may run from commencement to finish without the tubercle bacillus playing any appreciable part in the illness, or if present the bacillus is grafted upon pulmonary tissue already diseased and thus contributes to a more rapid ending of the illness. Pneumoconioses or dust diseases of the lungs are, therefore, both non-tuberculous and tuberculous, and if I were to choose a good example of such a malady it would be that of gold miners' phthisis. We must remember that so widely spread is tuberculosis that evidence of it in some degree is present in 70–80 per cent. of the bodies of patients dying in infirmaries from all causes. It requires little to light up a latent tuberculous lesion. Herein lies the necessity of care being taken to remove all possibility of dust irritating the lung and of the careless neglect of common colds. The presence in a workroom or factory of a tuberculous workman who expectorates anywhere is a danger to others. I do not say such a workman should be removed but spittoons should be provided containing antiseptics. In the same way dry sweeping of floors is dangerous. Floors should be previously wetted and should be swept when the people are out of the factory. This same remark applies to schools. The type of factory too has something to do with tuberculosis — those are the worst which are dark, damp and ill ventilated. So, too, home conditions play a part. I think I can give you a good illustration of this. When Captain Evans, the Antarctic explorer, was staying with me a few weeks ago, I discussed with him hygienic questions, one of which was the high mortality from tuberculosis among the fisher folk on the Norwegian coast. In this connection, Captain Evans obtained for me from Dr. Andvord of Christiania the following statistics for the years 1912–1914. These numbers are the mortality returns of tuberculosis per thousand inhabitants: In the center of Norway, 1–1.5 per thousand; in Stavanger and Bergen center, 2 per thousand; in the district immediately north of Bergen, 2–5 per thousand; in the district still further north of Bergen, 2–3 per thousand; and from there up to Tromsoe, the narrow part of the peninsula, 3–4.5 per thousand. In Newcastle, the tuberculosis death rate is 1.37 per thousand, so that in the northern half of Norway the deaths from pulmonary tuberculosis are three to three and one-half times greater than they are in Newcastle, and yet these people are living on the coast or close to it and are following a healthy but hazardous occupation. Clearly, occupation is not the cause of the high mortality rate

from phthisis in Norway, but overcrowding in dark and ill-ventilated houses, and poor food. That such factors are contributory is shown also by the rise of the tuberculosis mortality rate in young women workers in Newcastle during the war.

Dusty occupations play a part in causing pulmonary phthisis. Some dusty trades will show 54 per cent. of deaths from respiratory diseases, whereas among people living in the same district, but not occupied in dusty trades, there may be only 22 per cent. of deaths from these maladies. To such an extent may dust cause death, that of steel grinders in Sheffield in 1889–1910, 43 per cent. died from tuberculosis, and at the copper works in Montana, U. S. A., out of 1614 deaths during 1907 and 1914, 37.9 per cent. occurred in miners and were due to pulmonary tuberculosis; whereas among the non-mining class only 10.8 per cent. died from this disease. These facts certainly point to dusty occupations creating a soil favorable to the development of tuberculosis.

The shortness of time at my disposal will only allow me to draw your attention to one or two points in the pathology of the disease which may not be without interest to some of you. There are some physicians who hold that fine coal dust, since it is composed mostly of carbon, is not destructive, but may be really helpful to the lung in consequence of the small amount of calcium present in the dust. But coal dust varies: some contains a good deal of stony material and, while the carbon particles from their softness may do little or no harm to the lung, the same cannot always be said of the hard particles of stone which may be present.

One of the greatest risks coal miners are exposed to is the occurrence of explosions. These are not always due to gas but frequently to the firing of the fine particles of coal dust which are raised into the atmosphere by the draught of air whisking through the mine. How to lay the coal dust and render it harmless has been one of the problems which mine managers have been trying to solve for years. Spraying the walls and ledges of roadways by means of colloidal calcium, as Belger who worked in my laboratory suggested, has been tried and found to be effective. Another method to which Sir William E. Garforth gives the weight of his support is to powder the dusty surfaces with finely crushed shale, so that, if dust is raised into the atmosphere, the particles of shale interpenetrate with those of the coal, with the result that an uninflammable mixture is formed. We are not, however, at present discussing the prevention of explosions in coal mines. The point we have to consider is, whether, if finely pulverized stone dust is introduced into coal mines, some deleterious material may not be drawn into the lungs of the miners when at work and harm follow.

Northumberland coal is harder than that of the County of Durham: it contains a fairly large quantity of silica so that miners when winning coal must, during the active period of their lives, inhale a considerable amount of stony material, and yet it cannot be said that the mortality of Northumberland coal miners from pulmonary tuberculosis is unusually high. A similar remark applies to the Nottingham and Derby coal miners. In these counties the coal seams are fairly rich in crystalline silica and yet the death rate from lung diseases, up to the age of fifty-five years, is not only far below the average of men following other occupations, but is even slightly lower than that of the farm laborer. To Dr. John Haldane of Oxford we are indebted for new views upon this subject. It is generally admitted that all dust, unless it is soluble and chemically harmless, will, if inhaled, injure the delicate structure of the lung. Some kinds of dust, such as pure silica, may cause permanent injury to the lungs, whereas coal dust, notably coal and shale dust, may cause no

cumulative injury unless inhaled in large quantity. In Dr. Haldane's experiments various kinds of pulverized material were made use of, and dust was always found in the lungs after a lengthened period of exposure. Dr. Haldane also found if several weeks were allowed to transpire after inhalation of a dusty atmosphere that particles of coal and shale had considerably disappeared from the lungs, that the respiratory organs were gradually becoming clear again, whereas in the case of animals, exposed to an atmosphere impregnated with dust taken from the South African gold mines, there was no disappearance of the stony particles from the lungs. In these animals if still a few months longer were allowed to elapse, while the coal and shale dust might have entirely disappeared, the flint and quartzite particles from the Transvaal mines were just as abundant as immediately after the cessation of exposure to the dust. In my own experiments I was struck by the rapidity with which inhaled coal dust is removed by the large cells which become detached from the pulmonary alveolar wall — phagocytes which pick up the dust and are expectorated or make their way into the pulmonary lymphatics and deposit their burden in the glands at the root of the lung. Towards flint and quartzite particles there is not the same response on the part of the phagocytes and therefore the dust particles remain pretty much where they were. A coal miner's lung, if it is free from recurrent bronchial catarrh and is not too strongly impregnated with dust, can be fairly rapidly cleared of dust, whereas in the case of the gold miner and the Sheffield steel grinder and workers in some other dusty trades, the particles of inorganic material remain in the lung.

Since it appears, therefore, that the lung behaves differently towards different kinds of dust, we naturally ask ourselves why this should be so. Why do coal and shale particles disappear from the lungs of miners, while those of flint and quartzite are not removed, for in shale dust there is present a small quantity of quartz and the particles of dust are just as hard and angular as those obtained from the rock of South African gold mines ? So far as injury inflicted upon the lung is concerned, it does not appear that the injury is caused by the crude chemical composition of the dust. It depends in all probability upon the power which certain kinds of dust possess of absorbing other substances. In my address to the Congress of Hygiene and Demography in Washington, U. S. A., in 1912 I showed, as the result of experiments carried on over a period of many months, that coal dust and pieces of coal varied in weight from day to day, and that this was due to the power coal possessed of absorbing gas from the atmosphere: in a word, coal absorbs and evolves gas just as in ordinary respiration. It was quite different in my experiments with stone dust; with this there were no such interesting rises and falls of weight as with coal dust. Haldane has gone further and has suggested that insoluble dust particles are attractive and stimulating to the large pulmonary phagocytic cells in proportion to the soluble substances which the dust particles have themselves absorbed; that dust particles which have not absorbed such soluble substances or have done so only to a limited extent will be correspondingly unstimulating. Mavrogordato continued the experiments on Haldane's lines and allowed animals to breathe an atmosphere containing in suspension both coal and flint dust, with the result that when in due course he examined the lungs of animals which had inhaled the combined dust, the whole of the flint particles had practically been removed.

It appears, therefore, that since experience and experiment alike show that the inhalation of coal and shale dust when breathed in moderate quantities is not followed by permanent injury to the lungs,

since this kind of dust stimulates phagocytic activity, and since it appears that flint and quartzite particles which have reached the lung are also removed, there can be, therefore, little pulmonary risk incurred by coal miners when, in order to prevent explosions in coal mines, stone dust is sprayed upon the fine carbonaceous dust which is so frequently present in certain mines.

BOOK REVIEWS

Safety Fundamentals. Lectures Given by the Safety Institute of America. Cloth. Pp. 228 with illustrations, bibliography, and index. New York: Safety Institute of America, 1920.

This book is a collection of the ten lectures which comprised the series given under the auspices of the Safety Institute of America, February to June, 1919, to assist inspectors employed by the city of New York and the states of New York and New Jersey, and by insurance companies in and near New York City, to enlarge their knowledge and broaden their experience. The information contained in these lectures is intended not so much to aid inspectors in recognizing and eliminating the obvious hazards for which guards may easily be designed and applied, as to interest them in those subtle factors that are seldom appreciated and understood in safety work, but which are so largely the forerunners of accidents and which are intimately related to the worker's person and conduct.

The book may be divided into three parts. The first, which is composed of the first four lectures, treats subjects directly connected with the worker's person under the following headings: *The Body Which Gets Hurt; The Injured Body and Its Treatment; Protective Clothing for Men and Suitable Work Garments for Women;* and *Safe Heads and Good Eyes.* The second part includes the subsequent four lectures which cover specific matters closely associated with factory construction, i. e., questions of the guarding and the arrangement of machinery, heating, ventilation, and illumination. In the last part, comprising the ninth and tenth lectures of the series, the discussion is of a general nature. In his lecture on *Nature's Forces For and Against Workmen,* Mr. Rausch includes various hazards encountered, such as, hazards in methods of combating fire, smoke, and chemical hazards, hazards due to static electricity, explosive liquids and compounds, the wind, compressed air, dust, water, etc. The final lecture, *Safety Education and Shop Organization,* contains a discussion of the fundamental principles of safety and its by-products, and emphasizes the necessity of securing the hearty co-operation of the management, the foremen, and the men in the shop.

The extensive bibliography, which is appended to the lectures, is divided into ten parts, each containing suggested supplementary readings for each corresponding lecture. All the publications included are to be found in the Safety Institute's free reference library, where they may be consulted by anyone interested in safety work. — *R. M. Thomson.*

Sanitation for Public Health Nurses. By Hibbert Winslow Hill, M.B., M.D., D.P.H., Late Director, Division of Epidemiology, Minnesota State Board of Health, and later Director, Institute of Public Health; M.O.H., of London, Canada; and Professor of Public Health, Western University; now Executive Secretary, Minnesota Public Health Association; Author of "The New Public Health." Cloth. Pp. 211 with index. New York: The Macmillan Company, 1919.

This book was written for the purpose of giving to public health nurses a concise view of the fundamental requirements of public health nursing as it is today. Emphasis is placed especially on such aspects of the problem as may be included under sanitation, that is, sanitation as applied to disease prevention.

The author describes and discusses in non-scientific language the following common infectious diseases: typhoid, paratyphoid, typhus, scarlet fever, Dukes' measles and German measles, smallpox, chicken pox, diphtheria, tonsillitis, septic sore throat, Vincent's angina, whooping cough, mumps, colds, poliomyelitis and cerebro-spinal meningitis, syphilis and gonorrhea, tuberculosis, and leprosy. Immunity and anaphylaxis are defined and their attainment described. The theory and practice of epidemiology are considered chiefly in their application to the study of the transmission of disease from living body to living body, with a desire to interfere with that transmission. The fact that only a brief discussion of such questions as ventilation, food, water, milk, flies and parasites is included, is perhaps best explained by the following quotation from the author: "To advocate 'cleanliness' for the prevention of disease is to deceive with a false sense of safety those who, properly enlightened, might take the only real precautions that are effective." — *Maude Barton.*

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | AUGUST, 1920 | NUMBER 4

INDUSTRIAL POISONING IN THE MANUFACTURE OF AEROPLANES, EXPLOSIVES AND DYES*

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

I WISH to deal this evening with the way in which industrial poisoning attacks a worker, especially in those branches of industry which have come into such prominence during the war, namely, the manufacture of aeroplanes, explosives, dyes, and the process of dyeing. The first question one has to ask oneself in this connection is, "What is an industrial poison?" We can all define what we think a poison is — something which, when applied, acts chemically and effects transient or permanent injury to the tissues, organs, or functions of the body. But this is not enough in defining industrial poisoning; the outstanding point about an industrial poison is that it often acts without the knowledge of the worker and against his wish. I define an industrial poison, therefore, as one that is employed, produced, or somehow occasioned in an industrial occupation, and is brought about inadvertently and consequently against the will of the person poisoned, and, I might add, in the absence of sufficient precautions.

In general, the way in which these industrial poisons act (and the industries of which I am going to speak are good instances as showing the particular effects), is first, superficially on the skin, by their irritant and corrosive action; secondly, by absorption into the blood, the constituents of which they alter; and thirdly, by absorption into the system, with remote specific effect through the blood upon definite organs or tissues, as, for example, on the liver, on the heart, and on the nerves. There are only three ways in which industrial poisons can be absorbed, namely, (1) as gases or fumes, (2) as liquids, and (3) as solid substances or dust; and there are only three channels through which the industrial poisons can enter the system, namely, (1) by the lungs, in breathing them in as vapor or dust, (2) by the digestive tract in swallowing, and (3) through the skin itself by actual contact.

Several other points naturally have to be borne in mind in regard to an industrial poison, such, for example, as how far it is soluble in water, and how far it is able to dissolve fat (this latter is of special moment in the manufacture of explosives and dyes); the amount absorbed; the susceptibility of different individuals; age and sex; and lastly, the time it takes to absorb the poi-

* Lowell Institute Lecture delivered in Boston, Mass., Dec. 8, 1919. Received for publication Dec. 10, 1919.

son. The symptoms, when small quantities are absorbed, are usually of slow onset, while sudden absorption of large quantities brings about rapid onset of symptoms. The first type of poisoning is spoken of as chronic; the second, as acute.

The war has given us remarkable examples of industrial poisons absorbed through the lungs and through the skin. As regards the first, I cannot do better than describe briefly what happened at the commencement of the war in the manufacture of aeroplanes. No better example of poisoning by absorption of a vapor through the lungs, and of how it can be prevented, could be given. I shall refer to only one branch of the industry, namely, the covering of the wings which are made of linen fabric stretched over a light frame of wood, rendered impermeable and taut by a coating of dope and varnish. The basis of the dope consists of acetate of cellulose, but in order to apply this it must first be dissolved, after which it is applied with a brush. Shortly before the outbreak of war, certain organic compounds, chlorine compounds of ethane and ethylene, had been manufactured by an inexpensive process, and as they were non-inflammable they appeared to have a useful function as solvents of fat, resin and rubber. One of these, tetrachlorethane ($C_2H_2Cl_4$), which chemically is closely related to chloroform, was the compound which at the commencement of the war was employed as an ingredient of the dope, being present usually to the extent of about 12 per cent., the rest of the dope consisting of acetone, benzol and methylated spirits. The method of applying the dope is very much the same as in painting. Each doper carries the mixture in a can in his left hand, and with his right brushes it on to the wing, which is supported on trestles. Three or four coats of dope are put on, each coat having to dry before the next is applied. As the wing of an aeroplane is too wide for one person to stretch across it, two work simultaneously opposite each other. Each worker has to lean over the wing, and hence it is impossible to escape inhaling the fumes with which the atmosphere is charged.

The dope, however, is considerably heavier than the air, tetrachlorethane vapor itself being six times heavier, so that its fumes tend to fall to the ground. This is a very important fact to remember in explaining the manner in which the poisoning occurs. I will give an instance in point. Two months after the war began, a man died in an aeroplane factory with symptoms of jaundice, and when I went to the factory I found that nineteen men from all parts of the big shed were suffering from jaundice. The shed was a very large one, and had originally been a tramway depot. It was supposed to be very well ventilated by a plenum system — that is, by a fan which forced the air into the room through a system of air trunks with branch ducts opening about 2 feet from the floor level — but seeing that the vapor is heavy and collects on the floor, this system was the very worst that could have been adopted and served merely to stir up the vapor and distribute it to all parts of the shed. Although the smell of the dope was strongest, and the cases of illness most numerous among persons employed nearest to where doping was done, several slight cases occurred among those working in remote corners of the shed. Experiments with the different ingredients of the dope by Dr. Willcox, the Home Office expert on poisons, proved quite conclusively that tetrachlorethane was the substance which caused the ill effects. At that time, nearly all rooms in which doping was done, perhaps thirty in all, were using this dope, but in order to keep the fabric dry—a condition to which considerable importance is attached as the fabric, if moist, is apt to rot — the air was kept at a temperature of about 70°, and the ventilation was intentionally reduced to a

minimum. The conditions were, therefore, almost ideal for favoring poisoning by tetrachlorethane and, indeed, cases of jaundice, fatal and otherwise, occurred rapidly one after another in other factories.

Now, what was the remedy for this state of affairs ? One's first idea would be to give up the use of the poisonous substance, one's second, to introduce pure air and as constantly to remove it by fans, in order to reduce the amount of poisonous vapor present. Unfortunately, at that time it was impossible to give up the use of the material since no other substitute was known, and recourse was had, consequently, to the second remedy. The size of the wings made it impracticable to remove the vapor, as one would like to have done, by applying the exhaust ventilation locally at the point where the fumes arose. Hence reliance was placed by the Inspector of Dangerous Trades, Mr. W. Sidney Smith, on a low-velocity scavenge of the air contents of the dope room. In ventilating by this method fresh air at low velocity is drawn into the room by the suction of exhaust propeller fans, placed at the floor level because of the heavy nature of the fumes. Air inlets of ample size are placed on the other side of the room at a height of 8–10 feet, this air being warmed by passage through radiators or piping heated by steam or hot water. In considering the action of an open blade propeller fan, I always think of it as being like the thread of a screw. Each blade is placed at a certain angle to the axis and if all the blades were separated and joined up together they would make the thread of a screw. Each revolution of the fan transfers just as much air from the inside to the outside as is represented by the length of all the blades combined. The standard of ventilation for a dope room is thirty changes of air per hour, thus the whole of the air is changed every two minutes. You might think such rooms would be draughty, but there should be no perceptible draught if the apparatus is properly arranged. The secret of preventing draughts is to have the area of the fresh air inlets at least three times the area of the exhaust fans. At the beginning of the war there were, I said, about thirty dope rooms; at the end there were considerably over 400 and every one of them was ventilated very much on this principle of thirty changes of air per hour.

This is not quite the whole story in regard to doping. If there are poisonous substances which can be dispensed with in a factory, then naturally it is to everyone's benefit to get rid of them, and, seeing how impossible it was to remove the fumes at the point of origin, efforts were made to eliminate the use of tetrachlorethane. Fortunately by September, 1916, this was achieved. Before tetrachlorethane had been given up, at least seventy cases of jaundice with twelve deaths had occurred, but since that time there has been no death and jaundice has disappeared. The dopes now used, however, still contain benzene—usually in a proportion of about 19 per cent. — acetone substitutes, methylated spirit, and other ingredients, and the temperature of the room must be kept at 70° F. at least. In order, therefore, to make the conditions as healthy as possible — they cannot, I fear, be made exactly pleasant because of the alcoholic vapors constantly given off — the standard of ventilation adopted is still insisted upon and maintained. Other ameliorative measures are fifteen-minute breaks in the morning and afternoon spells, alternation of work, free medical supervision, and transference to other employment of those who show signs of fatigue or of the effect of the vapor.

A poison of another type, which acts by irritating and corroding the lining membrane of the lungs, is nitrous fumes. I have a dread of the insidious nature of these fumes because of the tragic reports which reach me of inquests on men who have

rashly repaired leaks in the nitric acid plant without protecting themselves by any form of effective respirator or helmet. Unfortunately, familiarity with the fumes breeds contempt in the workman. The full effect of inhaling nitrous fumes is not felt immediately. The worker, after having been gassed, is able to go on with his work for three or four hours, when he finds that his breath is becoming short and he has, perhaps, difficulty in getting home. Later on, he develops bronchitis or pneumonia. Longer exposure than two minutes in a building where there has been a sudden escape of fumes which envelop the workman will cause death from suffocation. If exposure lasts only from one-half to nearly two minutes, he may rapidly recover on being removed to the open air and soon feel as if the danger were over, but in these cases intense congestion of the lungs follows. Workers who daily experience small escapes of nitrous fumes have relaxed throats and slight chronic bronchitis. I should like to see in acid works and whereever there is risk of escape of nitrous fumes, greater precautions taken against the poisonous effect of the gas, and to make it part of the first aid teaching that no workman should undertake repairs when fumes are escaping without wearing a suitable helmet or appliance through which air can be supplied.

Mention of benzol introduces the subject of coal tar, in the distillation of which, as you know, it is one of the earliest products obtained, and this leads up to the coal tar dyes. Benzene, if breathed in large amount, will soon cause unconsciousness, and several accidents have been so caused by it, but always as the result of accident, breakage, leakage, or ignorance in entering a tank or still to clean it, without wearing an air helmet. As the preparation of benzol is nearly always carried on in an enclosed apparatus, there is usually little risk. When, however, small quantities are breathed daily for a long time, say for weeks or months, as has been done in the india rubber industry during the war, benzene has shown itself to be a powerful poison. Thus, in a certain factory where proofing of balloon fabric with rubber dissolved in benzene was carried on, symptoms resembling scurvy occurred in two of the men, with fatal results. These were the first recorded cases in Britain and they were due to the rapid evolution of benzol vapor in the air when the cloth saturated with solvent was dried in passing over the steam-heated tables. Other cases, however, are known to have occurred in America and on the continent, all showing the same symptoms. Benzene alters the constitution of the blood, so that the red and the white blood cells — especially the latter — are greatly reduced in number.

As with dope poisoning, so also in the case of benzene locally applied exhaust ventilation is impracticable, and, as a means of prevention, precisely the same method of ventilation by volume fans as used in dope rooms will have to be adopted in spreading rooms, where benzene is used as a solvent for rubber. Necessity being the mother of invention, a way out will probably be found in a new substitute, namely, xylol compound, which has been obtained in immense quantities since the outbreak of the war from mineral oil coming from Borneo.

Turning now to poisons which act directly by absorption through the skin, we find the best examples in the intermediate substances obtained from coal tar and used in the manufacture of explosives and dyes. I can best illustrate what I mean by two examples — anilin oil and trinitrotoluene. I remember very clearly an inquiry in Lancashire into the death of a workman in a dyeworks. It was a very hot day and the workman was taking the cork out of a cask of anilin oil when, probably because the heat of the sun had caused pressure inside

the cask — the work was being done in the open air — some of it splashed upon his face and clothes. He washed his face but did not change his clothes, and after working for an hour went home. He became unconscious and never recovered. It was noticed when he returned home that his lips were quite blue and that he staggered and appeared like a drunken man. In this instance the fact that the man did not change the clothes upon which the anilin had been spilt and did not rid his skin of it by a bath, led to his death from absorption through the skin, and it is in the same way in large measure that all illness from nitro derivatives of benzene and toluene is caused.

In pre-war time we knew very little of the effects of trinitrotoluene — so little was it used. The chief impression, however, was that it was much less poisonous than dinitrobenzene, with the injurious effects of which we had considerable experience in Huddersfield. As long ago as 1901, Dr. Prosser White, the medical officer at the Roburite Explosives Works near Wigan-and, and Dr. J. Hay of Liverpool, experimenting on themselves by rubbing into their skins small quantities of an ointment containing dinitrobenzene, showed unmistakably that it was quickly absorbed through the skin; and later, Dr. Malden of Cambridge went down to Huddersfield and Bradford and examined at the factory the blood of the persons engaged in making dinitrobenzene and dinitrotoluene, and in using anilin oil in the processes of anilin-black dyeing. In the case of the manufacture of D.N.B., it was shown quite clearly how rapidly absorption of the poison took place, and Dr. Malden pointed out that five of the twenty-one cases studied had been employed for one week or less, while only four had been employed for more than a year, and all had suffered from some symptoms of poisoning. The great effect of the compound was noticed in the change it brought about in the blood. The red blood cells varied very much in size, and were altered greatly in shape; instead of being round they became pear shaped and irregular in outline, and their number was diminished. Further, when the ear, for example, was pricked, the blood was not red but chocolate brown. The change was due to an alteration in the blood coloring matter, which prevented it from carrying oxygen from the lungs to feed the tissues of the body as efficiently as pure blood would do. In this way the symptoms of headache, drowsiness, shortness of breath, and blueness of lips were brought about. Very occasionally jaundice would appear, and in one fatal case which I remember at Huddersfield, the liver was found after death to be much diminished in size.

With regard to T.N.T., experience in pre-war time, as I said before, seemed to show that it was much less poisonous than D.N.B. Dr. Prosser White, indeed, had said it was not poisonous in ordinary use — a statement which was quite true at the time he made it, when no one could anticipate an extraordinary use of the material. It came as a surprise, therefore, when the workers in the National Filling Factories began to suffer from frequent illness, which in nearly all serious cases assumed the form of jaundice. Ordinary jaundice is never fatal, a fact which proved this new jaundice to be quite different, as the mortality rate among those suffering from it was very high — about 30 per cent.

The arrangements for the comfort and well-being of the workers in regard to change rooms, overalls, washing accommodation and meal-room accommodation had been well considered and the general plan of the factories in matters of lighting, heating and cubic space was satisfactory, yet as the poisonous nature of T.N.T. had not been anticipated, the conditions were for a short time baffling, both as to the essential cause of the trouble and the best means of prevention. In the process of fill-

ing with the molten amatol mixture containing T.N.T., with the pure T.N.T. in powder, or with ammonal mixture in powder, the quantity of fume and dust given off made one naturally forget White and Hay's experiments on skin absorption and attribute too much of the poison to inhalation of the dust and fume. Efforts, it is true, were made to prevent absorption through the skin by the provision of gloves, and to prevent inhalation of the dust by wearing respirators. It is easy to suggest the wearing of gloves, and gloves were provided and worn by the million, but they never adequately protected the skin since the powder or moist T.N.T. penetrated and percolated through, converting the gloves inside more into a poultice of T.N.T. than anything else. It was found also that the wearing of respirators for any length of time was impracticable.

In the summer of 1916, Dr. Benjamin Moore, working with his assistants in a T.N.T. factory for the purpose of discovering the cause of the trouble, repeated with T.N.T. very much the same experiments which Prosser White had made with D.N.B. He rubbed into the palms of his hands an amatol pellet containing 20 per cent. of T.N.T. In two hours traces of T.N.T. in the urine were noticed. He kept up the rubbing of amatol into his hands intermittently for about six hours, and for a period of ten days thereafter the presence of T.N.T. was detected chemically in the urine. During this time, Dr. Moore suffered from illness. Here, then, was proof that contact with T.N.T. ought to be avoided as much as possible. In this way the right measures of prevention were proved to be cleanliness of work, cleanliness in every meaning of the word, prevention of dust and of contamination of any part of the skin by the substance. Then began a campaign to achieve this in the factories. In addition to constant medical supervision and general welfare as to change rooms, washing, bathing, and the like, efforts were made to get rid of hand manipulation as far as possible. Mechanical means for filling shells with powder were introduced, and the shells protected from splashing in the operation of filling with molten T.N.T.; the congealed amatol on the trucks on which the shells were conveyed away was systematically removed by steaming instead of by the dangerous method of chipping; floors and benches were vacuum cleaned or mopped instead of swept down, and, as important as anything else, exhaust ventilation was locally applied wherever possible, in order to remove fumes and dust.

Effects of T.N.T. showed themselves in various ways. First — as is common with coal tar derivatives — there was a local effect on the skin, setting up inflammation which, however, quickly yielded to treatment; secondly, there was what appeared to be the same effect internally when the dust was swallowed — an irritative effect on the stomach causing gastritis and vomiting; thirdly, there was the effect produced on the blood, similar to but not nearly so characteristic or marked as that of D.N.B.; fourthly, as was not characteristic of D.N.B., there was a specific destructive effect on the liver cells, causing atrophy of the liver and jaundice; and lastly, a very rare form of anemia, always fatal, and due to the action of T.N.T. on the red marrow of the bones.

On January 1, 1916, it became the duty of every medical man treating a case of toxic jaundice contracted in a factory or workshop, to notify it to the Chief Inspector, and in this way we have since then been able to watch from month to month the progress of the measures taken to reduce the poisoning. The following figures, arranged in quarterly periods for 1916, 1917, and 1918 show how great was the increase of toxic jaundice at the end of 1916 and the beginning of 1917, and how, when we knew the cause and were able to take

effective measures, the improvements carried out in the factories eliminated much of the illness from T.N.T.

	1916				1917				1918			
	6^{4}	16^{5}	73^{21}	86^{22}	83^{12}	56^{20}	21^{8}	29^{4}	13^{4}	6^{2}	5^{2}	10^{2}
Total	181^{52}				189^{44}				34^{10}			

The small figures indicate fatal cases, and are included in the larger figures.

Finally, although the finished anilin dyes themselves may not be poisonous, several of them, such as chrysoidine, malachite green, and others, may act as violent chemical irritants to the skin, or rather to that part of the skin immediately under the cuticle where the blood vessels are spread out in a wide network of capillary vessels. One of these anilin dyes — aurantia or Emperor's yellow — which at one time was used for coloring cheap shoes, caused so violent an eczema that its use industrially was quite given up. The last time it was used to my knowledge was by the Germans as an ingredient of their bombs in a daylight attack on London. You remember after the raid a number of persons noticed a reddish-brown powder surrounding spots where bombs had fallen and did not explode. Many of those who touched or swept up this dust were attacked ten days later by a very severe inflammation of the hands. These dye substances penetrate to the blood vessels immediately under the skin and there they set up a reaction, with slowing of the blood current, dilatation of the blood vessels, the passage through them of plasma and white blood cells, and all the symptoms of inflammation — redness, swelling and pain.

Industrial eczema is very common, especially in the dye industries, if the substances setting it up are continually used. The substances causing eczema are: first, those which dissolve and remove the natural grease from the skin, such as turpentine, petroleum, benzene and its homologues and their nitro and amido derivatives; second, substances or processes which soften and macerate the skin, such as alkalites (soap and soda), or even continuous contact with water; and third, substances or processes which chemically or mechanically injure the continuity of the cuticle, such as brushing, scratching and rubbing, for the natural protection of the skin is its toughness and elasticity. The close union of the horny cells in the uppermost layers forms a sort of armor plating, and, when unbroken, prevents the entrance of germs (which are always present on the surface of the skin) and irritants. Further, the glands in the skin, which are of two kinds — the one the sweat glands, and the other the sebaceous glands attached to the hair follicles — constantly exude a useful oil and waxy, waterproofing material. The most important thing, therefore, in the way of protecting his health that the worker in the dye industry can do is to look well after his skin, and see to it that by frequent washing and bathing it is maintained in a healthy state. When the skin becomes dry and cracked by the substances used dissolving out the skin grease, the most important thing in treatment is to try and restore as far as possible the natural lubricant to the skin. This can be done, first, by careful washing after work so as to remove all the soap, and by thorough drying — unless drying is thorough, the skin becomes dry or chapped — and by smearing on a little of an ointment like lanoline and castor oil in equal parts, in just sufficient quantities to make the skin feel moist.

If irritating powders are being handled, it has been found much the best thing to protect the skin by dusting it with a dry powder like zinc oxide or starch, rather than by smearing on vaseline or ointment, since the noxious powders only cling to and collect on the ointment. This has been the experience during the war with the extremely irritating tetryl powder used as the detonator in fuses.

Not infrequently eczema spreads from the hands to other parts of the body with resulting pimples and boils. This is not the effect of the chemicals used, but indicates that germs on the skin have infected the original exudation, finding there a suitable nutrient medium. One of the great objects of early treatment, therefore, is to prevent these secondary infections which are much more intractable than the original eczema. Although it is true that the skin has a wonderful power of accustoming itself to the irritants to which it is exposed, by becoming thicker in places, it is hardly safe to rely on this, nor is it wise to explain freedom from eczema by saying that one workman is more susceptible than another. There is certainly often greater capability in one worker than in another to withstand the effect of irritating substances on the skin, but before accepting this view one ought to exclude certain factors in the work or in the way of doing it, such as carelessness, increased exposure, longer hours, or exposure to a higher concentration of the injurious ingredients. Some people, however, are so susceptible that they cannot go near an open bottle of one or another chemical without suffering. In such cases the only thing to do is to recommend the workman to seek other employment. This perhaps is more frequently done in the case of chrome dyeing than in any other process. Protection against chrome ulceration has, however, in my opinion, not been sufficiently tried. Chrome in solution in the dyeing trade, being a strong oxidizing agent, when it comes into contact with a broken surface in the skin will cause a hole or ulcer, and so long as the broken skin is uncovered every contact with chrome will tend to make the ulcer worse. If the fingers and hands, however, are regularly inspected and if abrasions are thoroughly washed and then covered with a waterproof plaster, no chrome will get in, and work may be continued. Instead of a chrome hole, in some very sensitive skins, eczema breaks out. In such a case as this the solution has penetrated the apertures in the skin for the small hairs. These hair follicles are portholes and catchment points so that it is all the more necessary to try and keep the skin covered with a fatty layer.

An eczema is much more likely to be widespread when the hands are soaked in solution or exposed to steam. On the other hand, where oil is the vehicle, one can see quite plainly how the oil chokes up these portholes and so leads to inflammation, and to pimples and boils. Only by thorough cleanliness, washing with warm water and soap, can the plugs be prevented from accumulating in the hair follicles, and acting as a focus of irritation and infection.

CADMIUM POISONING *

G. ARBOUR STEPHENS, M.D., B.S., B.Sc. (Lond.)

Certifying Factory Surgeon, Swansea, and Hon. Physician, Royal Cambrian Institution for the Deaf

THESE notes refer especially to one case, but the findings of the case crystallise what had previously been thoughts held in solution. I have unusual opportunities for comparing illness, usually attributed to lead poisoning, occurring among men employed in smelting lead and among men employed in smelting zinc, and have long recognised that the type of ill health differs in the two cases.

A man, aged 67, who had worked for many years at spelter works died in January, 1920, after having been paid compensation during ten years for what was allowed to be "plumbism," the chief symptoms being weakness, wasting and a tendency to bronchitis. At the *postmortem* examination the kidneys showed marked evidence of chronic interstitial nephritis and the heart was hypertrophied. Some of the liver was reserved for analysis by Mr. Seyler, the borough analyst of Swansea, who reported as follows: "The liver contained no lead and only a trace of copper. It also contained cadmium, 0.91 grains per pound, and zinc, 0.77 grains per pound."

The question naturally arises whether this really was a case of plumbism in which the lead, after having done some damage, had passed out of the system altogether, leaving behind, however, quantities of cadmium and zinc. Experiments dealing with the removal of lead from the system are very vague; none exist to show that lead is eliminated more quickly than cadmium or zinc; and until such experiments are forthcoming we can take it that the rate of excretion is probably the same for all three. On this assumption, the inference follows that if the case was one of metal poisoning, it was not one of lead poisoning; but that the active agent was cadmium or zinc or both.

During the last six years I have had eight cases of a similar nature where the analysis showed cadmium in quantities varying from 0.094 to 0.91 grains per pound, and zinc from 0.03 to 0.77 grains per pound; whilst the amount of lead has been, if any, merely a trace. The comparison between these cases from spelter (i. e., zinc smelting) works and others from lead smelting works is striking; in the analysis of livers of men who had worked in lead smelting, no other metal than lead was found.

Zinc Smelting

Spelter, the trade name for zinc, is obtained by mixing (a) calamine, (b) calcined blende (i. e., zinc sulphide from which the sulphur has been driven off by heat in the form of sulphur dioxide), and (c) carbon, in the form of very finely divided anthracite coal, and distilling the mixture in a series of baked clay retorts which are heated by producer gas, consisting of carbon monoxide and carbon dioxide. The red-hot retorts are filled by men under trying conditions; when the wind is blowing from a bad direction, smoke and fumes are blown down on the men; when the weather is very warm, they get heated and sweat profusely. Unfortunately the men are very careless as to the way they eat, drink and smoke, giving but little heed to the necessity for cleanliness, and getting but little encouragement in this direction. The retorts, which, though smaller than gas retorts, are set in a somewhat similar way, are arranged in rows. The top row of about twenty-five re-

* Received for publication March 23, 1920.

torts is charged first of all, and then a lower row; but whilst the lower retorts are being charged fumes are commencing to come off from the upper ones. These fumes, in spite of ventilating arrangements, come into close contact with the men.

Calamine, which consists of 35 to 45 per cent. of zinc, contains cadmium to the extent of 0.5 to 1.5 per cent.; and, as it is more volatile than zinc, the first lot of fumes contain cadmium. When all the retorts are charged their mouths are covered by "pipes" into which the zinc distils. These pipes are later covered over by nozzles in which the more volatile zinc is collected as zinc dust or oxide (together with some cadmium oxide) so that there is then less chance for the zinc to get into the men's faces.

Previous Observations

The fact that cadmium, which rarely exceeds more than 1 per cent. in the ore, is found in greater quantity than zinc in the livers of spelter workers is a very striking fact and one that deserves consideration. Hayhurst (1) points out that practically all recent authorities are agreed that zinc *per se* is non-poisonous. Sir Thomas Oliver (2) states that he could not find any evidence of ill health due to zinc itself, but adds that respiratory affections were common among zinc workers owing to chilling of the body when in a state of perspiration, and that rheumatic affections were complained of. According to Professor Thompson of Cornell University zinc fumes disorder digestion and irritate the stomach, causing gastralgia, nausea, and vomiting.

Neither of these authors refers to the effects of cadmium, but Dr. Legge has kindly drawn my attention to Erben's (3) observation that: "Soluble salts of cadmium resemble those of zinc (cadmium is more easily absorbed than zinc) but they are at all events more poisonous. Cadmium salts cause ulcerative gastro-enteritis and as they are excreted through the intestines and kidneys chronic poisoning sets up gastro-enteritis, nephritis and degeneration of the organs, while gastro-enteritis, convulsions, coma, slowing of the respiration and pulse, result from acute poisoning. Cadmium sulphide used as a paint is non-poisonous as it is insoluble. As the metal, it is used to make solders of low melting point." Kobert (4) says that: "Cadmium resembles zinc physiologically, toxicologically, and chemically. Lethal doses in guinea pigs, 0.15 to 0.30 grammes per kilo body weight. In man, recorded that 0.039 grammes of cadmium sulphate caused vomiting, salivation and tenesmus. Animal experiments — inflammation of bowel and nephritis. Cadmium sulphate twice as poisonous as zinc sulphate."

Athanasiu and Langlois (5) carried out sub-acute and chronic poisoning on animals. "Death resulted from inanition and gastric disturbance. Postmortem: gastro-enteritis, nephritis and a very chronic fatty degeneration of heart and liver."

Kunkel (6) says that cadmium is present to the extent of 5 per cent. in Silesan calamine. As it is more volatile than zinc it comes off first in the zinc distillation process. Of the compounds, cadmium oxide, as well as the soluble salts, is pronounced as poisonous. "The fullest experiments on the subject (Marme: Zeitschr. f. rat. Med., 1867, Vol. III, No. 29, page 125) show that soluble cadmium salts have a local effect — from burning sensation in the mouth to vomiting and diarrhea. Further, there are more remote effects, such as vertigo, feeling of weakness, slowing of the pulse and respiration, loss of power, unconsciousness, convulsions. In animals the symptoms of chronic poisoning consist in disturbed digestion and advancing emaciation. Anatomically have been shown gastro-enteritis, hemorrhages under the pleura, infarcts in the lung, fatty liver and heart muscles, diffuse inflammation of the kidney. Cad-

mium is, therefore, a much stronger poison than zinc."

Personal Observations

During the entire period, extending over several years, that I have been connected with lead and spelter works I have been impressed with the fact that the symptoms — all said to be due to plumbism — differed according to the works at which the patients had been employed.

Lead colic is a symptom once seen never forgotten; the agonising paroxysms are characteristic; the patients roll about the bed or floor groaning or screaming. But I have only seen it in men from the lead works. The gastric symptoms of men who have worked at spelter works consist of marked pain or tenderness at the epigastrium, associated with nausea and some constipation. The patient is dull and heavy, with loss of appetite, thirst, an unpleasant taste in the mouth and a thickly furred tongue. In some cases there is *diarrhea*. On reference to the above quoted authorities, the symptoms would appear to be similar to the irritating effects produced by cadmium. Workers in dusty zinc oxide factories do not exhibit such symptoms; but cadmium is absent from the zinc used for this purpose. Further, these symptoms are not (I am informed by Professor E. L. Collis) exhibited by men employed in redistilling zinc from the remainders or ashes of galvanising pots, although the retorts and furnaces used are exactly the same as those used in zinc smelting; but, as the temperature at which galvanising pots are worked would be sufficient to drive off any trace of cadmium from the zinc, these remainders must be practically free from cadmium. Cadmium, on the other hand, is readily given off from zinc-smelting retorts during the period before the nozzles are fixed; it is said to be more readily absorbed and to be physiologically more powerful than zinc; and the natural conclusion is that cadmium is responsible for the gastric disturbances among spelter workmen.

This gastritis caused by cadmium probably gives rise to an increased and more active area of absorption whereby any lead that is present in the blende has a chance of getting into the system. That gastritis prepares the way for lead absorption is borne out by the following facts. Previous to the time when I insisted on men who were starting at the lead works putting their mouths in order by having all their foul and rotten teeth extracted, it was very usual for fresh workers from the country to be laid up with colic in the first few weeks; now we never find such an occurrence, for by the removal of the oral sepsis, the stomach is able to digest the more luxurious dietary, especially in the form of meat, in which, due to their much higher wages, the men are prone to over-indulge. Alcohol no doubt plays a part in predisposing men to plumbism, but as this factor has not been eliminated one must credit the introduction of the above mentioned dental precaution with the good results.

The rheumatic affections referred to by Oliver as being prevalent in spelter workers may, I think, be ascribed to auto-intoxication from deranged stomachs which sometimes give evidence of acute gastritis, but more often are chronically and progressively disturbed.

Conclusions

1. Cadmium belongs to a group of heavy metals some of which are recognised to possess toxic properties.

2. Cadmium has been found experimentally and industrially to possess toxic properties.

3. Men employed at zinc smelting are exposed to the absorption of cadmium in the form of fumes.

4. After death cadmium is found in ap-

preciable amounts in the organs of the body.

5. These men experience symptoms atypical of lead poisoning as seen among lead smelters, but similar to those attributed by other writers to cadmium.

BIBLIOGRAPHY

1. Hayhurst, E. R.: Diseases of Occupation and Vocational Hygiene, edited by G. M. Kober and W. C. Hanson. Philadelphia, P. Blakiston's Sons & Co., 1916; London, W. Heinemann, Ltd., 1918, p. 18.
2. Oliver, T.: Diseases of Occupation. London, Methuen & Co., 1908; New York, E. P. Dutton and Company, 1916, p. 222.
3. Erben: Vertgiftuugen, 1909, Vol. 1, p. 432.
4. Kobert: Lehrbuch der Intoxicationen, Vol. 2, p. 399.
5. Athanasiu, J., and Langlois, P.: Recherches sur l'Action Comparée des Sels de Cadmium et de Zinc. Arch. de physiol., 1896, **28**, 251.
6. Kunkel: Handbuch der Toxikologie, 1899, p. 175.

INDUSTRIAL LIGHTING CODES *

LOUIS BELL, Ph.D.
Consulting Electrical Engineer

THE protection of workmen from eye strain due to the conditions of their occupation has of late years been recognized as a matter of serious importance. Traumatic injury from occupational causes has been long a matter of concern, but eye strain as such is no less harmful to industrial usefulness, and should have at least equal consideration. It arises chiefly from two causes — insufficient light for easy seeing, and misdirected light, producing glare. In either case the eye attempts to protect itself by muscular effort and the result is the condition of eye strain, producing directly painful and unpleasant symptoms, and, indirectly, nervous affections such as generally accompany prolonged effort to accommodate the organism to uncomfortable conditions. If everyone possessed quite normal vision and could stay young the situation would be easier, but as a matter of fact only a small proportion of the population can fairly be called emmetropic and the inevitable loss of accommodation with increasing years not only aggravates existing errors of refraction, but may bring added strain from vain attempts at the near vision sometimes required by the occupation.

Dr. George M. Gould in a recent paper has estimated that, taking the population as a whole, approximately between 40 and 50 per cent. are victims of ocular or eye-strain diseases, using disease in its broader signification. Dividing the population into groups, the proportion thus afflicted begins with the group having outdoor occupations in which less than one person in five is affected, and ends with the group engaged in work requiring the minutest application, such as die cutting, proof reading and diamond polishing, in which more than four out of five suffer from eye conditions. The importance of occupational affections of the eye is, therefore, very strongly emphasized and has indeed been widely recognized — perhaps never better than in a recent report of the Massachusetts State Board of Health, in which the following statement occurs:

> It is a well-established fact that either the over-use of the eyes or the use of eyes under bad conditions may give rise to eye-fatigue or to eye strain; and many eye specialists believe that at least 80 to 90 per cent. of headaches are dependent upon eye strain. It is impossible to ignore the probability that many individuals working by gaslight, or even by electric light, in dirty, unpainted, overheated rooms, with impure air and excessive moisture, for ten hours a day or merely for the last two hours during the day, use up a great deal of nervous energy, and suffer from eye-fatigue, or eye strain, and its consequences.

Aside from this, there is a strong probability that bad lighting, especially in passageways, halls, and stairways, is responsible for a material increase in accidents. The mere fact that, according to the statistics given the writer by an accident insurance expert, 18 per cent. of industrial accidents occur in these places, points directly to the need of ample lighting. The Chief of the Bureau of Electric and Mechanical Equipment of the Department of Labor in the state of New Jersey informs the writer that one matter forcibly brought to the attention of the department was the large number of tripping accidents in work spaces, aisles, passageways and exits, investigation of which showed clearly that

* Received for publication May 29, 1920.

in many cases objects had been left in these spaces where, due to poor lighting, they had not been noticed by the injured person. In some cases it was found that sharp contrast of light and shadows caused the accident, in others an insufficient light intensity. By reason of these various conditions the states of New York, New Jersey, Pennsylvania, California, Oregon and Ohio have adopted industrial lighting codes requiring certain minimum amounts of light to be furnished for industrial operations and for passageways and exits, together with suitable precautions against the effects of glare. These codes have been in the main based on a tentative code drawn up by the Committee of the Illuminating Engineering Society, afterwards adopted by the Committee on Labor of the Council of National Defense, and widely promulgated as a suitable standard. (See page 136.)

The several codes differ somewhat in detail, but have in general the following provisions. First, a minimum intensity of illumination is required for industrial operations, ranging from about 1 foot-candle for the coarsest manufacturing work to 5 foot-candles for the finest—intensities which are obligatory. Second, a specified minimum illumination is required for passageways, exits and stairways, with special reference to preventing the class of accidents which occur in these places. Third, all the codes contain provisions against glare, more particularly that which arises from having bright, unscreened sources of light within the field of view of the workers. This is an old and well-known source of ocular trouble which not only is liable to create serious eye strain but also badly hampers the operations under way by interfering with easy vision. The provisions directed toward this end of eliminating glare, including violent contrasts of light and shade, vary somewhat in detail but are generally of fairly effective character. They particularly aim toward keeping unscreened sources of light high enough to be out of the ordinary field of view, and toward adequate screening by suitable shades of those light sources which, from the conditions of illumination, cannot be so placed. Finally, in order to prevent accidents associated with panic resulting from the extinguishment of the regular lighting system, the codes generally contain provisions for at least a certain amount of independence in the lighting for passageways, stairways and exits, so that the failure of the work room lighting will be unlikely to involve proper lighting of the way out.

These codes, it should be understood, are intended directly to promote the safety and comfort of the workman and are concerned in no way with the better illumination which, as a matter of experience, has been found to promote industrial efficiency. This latter is a matter for the employer and the workman, but is without the scope, as yet, of mandatory regulation. The need of such codes is very quickly impressed on anyone who has occasion to visit industrial establishments. Many such establishments are, in fact, found to be very badly illuminated, so that after dark the workers are plainly struggling to see — a fact which any ophthalmologist would quickly recognize from the attitudes and expressions characteristic of eye strain. Often these bad conditions may be found in small shops where comparatively close work is going on, and not infrequently in larger works which have been in operation for many years — works in which perhaps machinery has been improved to promote more efficient manufacturing, but in which the same old, inefficient and injurious lighting system installed years ago is retained. Bare incandescent lamps so placed as to shine directly into the eyes of the workman are probably the commonest source of trouble. The old carbon incandescent lamp was bad

enough when so misused. As it has been replaced by the metallic filament lamps and still later by lamps having gas-filled bulbs, these conditions have gone from bad to worse until they are now, in many instances, quite intolerable. Add to this, illumination on the work insufficient in amount, and one has a combination which is a matter for serious anxiety. With suitable shades not only would the dangerous glare be eliminated, but more light would be directed on the work — light which is now utterly wasted.

The relief of eye strain is equally desirable for the employer and for the employed. The employer feels the results of eye strain on the part of the worker in the less effective work performed and in the increased absenteeism from the concomitants of eye strain and a considerable chance for accidents. Increase in the intensity of the illumination, provided accompanying glare is eliminated, undoubtedly will do much toward lessening occupational troubles with the eye, since there is good reason to believe that with decrease of illumination below a high physiological standard there is an increase of eye strain in geometrical ratio. The physiological standard is roughly set by the capacity of the eye to attain its normal acuity and shade perception. This capacity has been pretty thoroughly investigated for a good many years past and serves as a basis for setting mandatory intensities for various industrial conditions. The finer the work — and especially if on material of dark color — and the closer the attention required in manufacture, the more illumination must necessarily be furnished for safe working.

Quite aside from this is another phase of the matter which has to do with the increase of industrial efficiency. In the last few years there have been many experiments on the extent to which an operation, capable of being carried on at a certain illumination, gains in facility when this illumination is increased. It has been found by experiment that quickness of vision demands much higher intensities than the mere recognition with certainty of the same detail. It is now not uncommon to find factories provided with illumination three or four times the minimum code requirements and with great gains in quantity and quality of production.

Broadly, therefore, the application of the lighting code is a step toward improving production — not a long step for it is gauged merely by the safety of the workman, but a step altogether in the right direction. Considerable opposition has been made to the introduction of industrial codes on the part of some rather short-sighted employers, usually based on contentment with conditions which have been endured in the past, on intense dislike of any legislative interference, and often on a somewhat unwarranted fear of costs. Inasmuch as at ordinary costs for electric service an additional illumination of 1 foot-candle costs for energy only from 60 to 80 cents per hour per acre of space illuminated, comment on this last phase of the matter seems hardly required. The codes are going ahead now somewhat rapidly, and various states, including Massachusetts, are now working on the problem with an earnest desire to improve the industrial situation. If all employers were as keen to better their conditions of production as some have already proved to be, legislative action would become unnecessary. As the human case stands, however, nothing but the enactment and enforcement of codes will bring about the much needed relief which the workers of the country deserve, and which they must have.

GENERAL LIGHTING SAFETY ORDERS *

Order 1501.

General Requirements

(a) Working or traversed spaces in buildings or grounds of places of employment shall be supplied, during the time of use, with either natural or artificial light in accordance with the following Orders (1502–1509).

Order 1502.

Natural Lighting

(a) Windows, skylights or other roof-lighting construction of buildings shall be arranged with the glass area so apportioned that at all the darkest part of any working space, when normal exterior daylight conditions obtain (sky brightness of 1.50 candlepower per square inch), there will be available a minimum intensity equal to twice that of Order 1503, otherwise artificial light of intensities specified in Order 1503 shall be provided.

(b) Awnings, shades, diffusive or refractive window glass shall be used for the purpose of improving daylight conditions or for the avoidance of eye strain wherever the location of the work is such that the worker must face large window areas through which excessively bright light may at times enter the building.

Note. — The intensity requirements for adequate day lighting are much higher than those for adequate night lighting, because in general under daylight conditions the light reaching the eye from all surroundings in the field of vision is much brighter than at night, and hence a correspondingly more intense light must fall on the object viewed.

* Code issued by the Industrial Accident Commission of the state of California, the latest in force at the time of writing, and typical of the codes based on the general recommendations of the Illuminating Engineering Society.

Order 1503.

Artificial Light

(a) When the natural light is less than twice the minimum permissible intensities of illumination set forth in the following table, artificial light shall be supplied and maintained in accordance with the table.

Note. — See Appendix for intensities recommended for best working conditions.

	Foot-candles at the floor level
1. Roadways and yard thoroughfares	0.02
2. Storage spaces, stairs, stairways, halls, hallways, passageways, aisles, exits and elevator entrances	0.25
3. Watercloset compartments, toilet rooms, washrooms, dressing rooms and elevator cars	0.50
	Foot-candles at the work
4. Work not requiring discrimination of detail, such as handling material of a coarse nature, and performing operations not requiring close visual application	0.50
5. Rough manufacturing requiring discrimination of detail, such as rough machining, rough assembling, rough bench work, also work in basements of mercantile establishments requiring discrimination of detail	1.00
6. Rough manufacturing requiring closer discrimination of detail, such as machining, assembly and bench work, also work in basements of mercantile establishments, requiring closer discrimination of detail, intermediate between 5 and 7	2.00
7. Fine manufacturing, such as fine lathe work, pattern and tool making, also office work, such as accounting and typewriting	3.00
8. Special cases of fine work, such as watchmaking, engraving and drafting	5.00
9. Processes otherwise safeguarded in which light is detrimental	0.00

Note. — Some exceptions to the intensity rule:

(a) There are some operations that are performed in comparative darkness, as for

example, photographic processes in the dark room.

(b) There are some operations that are best observed by their own light, as in parts of the process of working glass.

(c) Some operations are best observed by the "silhouette" method of lighting in which the work is seen against a lighted background in a comparatively dark room, as in some processes of working with dark threads and lamp filaments.

In all such cases in which work is of necessity carried on in comparative darkness, special precautions should be taken to properly safeguard the workmen.

Order 1504.

Measurements

(a) For the purpose of light measurements, a standardized photometer, certified by the Industrial Accident Commission of the state of California, shall be used, and such measurements shall be made at the locations specified in the table.

Order 1505.

Shading of Lamps for Overhead Lighting

(a) Lamps suspended at elevations above eye level less than one-quarter their distance from any positions at which work is performed, or where places are traversed, must be shaded in such a manner that the intensity of the brightest one-quarter square inch of visible light source shall not exceed 75 candlepower per square inch.

Exception. Lamps suspended at elevations greater than 20 feet above the floor are not subject to this requirement.

Note 1. — Glare from lamps or unduly bright surfaces produces eye strain and increases the accident hazard. The brightness limit specified in this Order is an absolute maximum. Very much lower brightness limits are necessary in many interiors illuminated by overhead lamps, if the illumination is to be satisfactory. In some cases the maximum brightness should not exceed that of the sky (2 to 3 candlepower per square inch).

Note 2. — Where the principal work is done on polished surfaces, such as polished metal, celluloid, varnished wood, etc., it is desirable to limit the brightness of the lamps in all downward directions to the amount specified in this Order.

Note 3. — For method of measuring brightness, see Appendix, paragraph 86.

Order 1506.

Shading of Lamps for Local Lighting

(a) Lamps for local lighting must be shaded in such a manner that the intensity of the brightest square inch presented to view from any position at which work is performed, shall not exceed 3 candlepower.

Note. — In the case of lamps used for local lighting, at or near eye level, the limits of permissible brightness are much lower than for lamps used for overhead lighting, because the eyes are more sensitive to strong light received from below, and because such light sources are more constantly in the field of view.

Order 1507.

Distribution of Light on Work

(a) The reflector or other accessories, mounting heights and spacings employed with lamps shall be such as to secure a reasonably uniform distribution of illumination, avoiding objectionable shadows and sharp contrasts of brightness. If local lighting is used, there shall be employed in addition a moderate intensity of overhead lighting, with a minimum of not less than one-fourth foot-candle.

Exception: Where the light from the local lamps falls principally upon surfaces

which are white or nearly so, and the ceilings and walls of the rooms are light, there is often a sufficient general illumination received indirectly by reflection to obviate the necessity of additional overhead lighting.

Note. — When local lighting is used as the sole source of illumination of an interior, the field of illumination from each lamp is in contrast to the surrounding darkness, thereby causing eye strain and increasing the accident hazard.

Order 1508.

Emergency Lighting

(a) Emergency lights shall be provided in all workspace aisles, stairways, passageways, exits, outside landings of fire escapes and other structures, used as regular or emergency means of egress. These emergency lights are to provide for adequate illumination when, through accident or other cause, the regular lighting is extinguished.

Note 1. — It is the intention of this Order to guard against accident due to the failure of the regular lighting system, by providing sufficient illumination to enable the occupants to:

(1) Avoid contact with moving machinery and other danger points until the regular lighting is again placed in operation.

(2) To vacate the building safely and expeditiously when this is necessary because of fire or other causes.

Note 2. — Emergency lighting may be installed in various ways. The method to be employed depends upon the size of the premises, the extent of the hazards of employment, and the means available for supplying such emergency lighting.

(b) Emergency lighting systems, including all supply and branch lines, their runways, raceways and supports, shall be entirely independent of the regular lighting system, and shall be lighted concurrently with the regular lighting system and remain lighted throughout the period of the day during which artificial light is required or used.

(c) Emergency lighting shall have a minimum intensity of one-fourth foot-candle. The emergency illumination shall not exceed 50 per cent. of the distributed illumination.

(d) Emergency lighting systems shall be supplied from a source independent of the regular lighting system in theaters, public meeting halls, moving picture exhibition places, hospitals, schools, and any other place where the nature of the hazard is such as to require it, except where an exemption is granted by the Industrial Accident Commission. This source of supply and controlling equipment shall be such as to insure the reliable operation of the emergency lighting system when, through accident or other cause, the regular lighting system is extinguished. Where a separate source of supply cannot be obtained for the emergency lighting, the feed for emergency lighting must be taken from a point on the street side of the service equipment. Where source of supply for the regular lighting system of sufficient capacity to supply all emergency lighting must be installed from some other source, a suitable storage battery, or separate generating unit may be considered the equivalent of such service.

Order 1509.

Switching and Control Apparatus

(a) Switches or other controlling apparatus shall be so installed that pilot or night lights may be controlled from a point at the main entrance, and from other easily accessible points. Pilot or night lights may be a part of the emergency lighting system.

(b) All switching and control apparatus on emergency, pilot and night lights shall be plainly labeled for identification.

Note. — The purpose of this Order is to make it possible for the night watchman or other qualified persons to turn on enough lamps, when entering any portion of the premises at night, to enable them to safely see their way around without the need of a lantern or flashlight.

CHRONIC POISONING FROM CYANOGEN CHLORIDE*

C. I. REED
Department of Physiology, University of Kansas

IT is the purpose of this paper to present some clinical and experimental data on chronic cyanide poisoning, concerning which there has been some confusion of opinion. A survey of the literature on this subject brings to light many reports of poisoning by cyanides with recovery, in many of which cases there were no chronic symptoms. Cohen (1) and Wilkes (2) both report such cases.

On the other hand there are many reports, both clinical and experimental, of chronic effects. Souwers (3) and Boddaert (4) both report chronic effects, but only from repeated exposures. Collins and Martland (5) report a case of peripheral neuritis with eventual recovery, as a result of repeated exposure to a solution of hydrocyanic acid of unknown concentration. Schlegel (6) reports as an experimental result of repeated administration of sublethal doses of cyanide, chronic cachexia with increased susceptibility. Koritschöner (7) found, in an attempted treatment of tuberculous patients with hydrocyanic acid gas, that definite chronic symptoms resulted from which there was rapid recovery after cessation of the treatment.

Winternitz (8) claims that halogen cyanides produce pulmonary edema and congestion which is very persistent, but this is evidently due to the halogen radical as we will attempt to show later in this paper.

Quite recently Fühner (9) has made an experimental study of hydrocyanic acid poisoning in connection with its use as a germicide, in which he found symptoms of acute poisoning, consisting of salivation, metallic taste, lingual petechiae, reddening of the forehead, general weakness, lowered blood pressure, thoracic muscular pains, general malaise and vomiting. He is inclined to the view that repeated doses do not produce chronic poisoning but *may* increase susceptibility.

The author has already reported a series of experiments on repeated exposures to hydrocyanic acid from which it is apparent that chronic symptoms occur only on repeated exposure, a severe exposure that is not immediately fatal producing only fleeting effects, though long exposure to very low concentrations may produce mild chronic effects. Furthermore, there were no manifestations of increased susceptibility but some indication of a certain degree of tolerance (10).

Interest in this subject was aroused by the report of certain symptoms noted by men employed in a small plant engaged in the manufacture of cyanogen chloride. Although this did not come to our attention until after all of the men had been relieved of this work, so that no objective symptoms could be recorded, careful questioning of the men brought out a fairly definite clinical picture. These men were exposed daily under conditions which did not permit of persistence of a high concentration but there was continually a certain amount of escaping gas. Some of the men very rarely took any protective precautions, which indicates that the concentration cannot have been very high. Histories were obtained from fourteen men who were all in good physical condition at the beginning of their period of employment. A typical history is presented in brief, together with a statement of the more striking individual manifestations.

This typical subject was exposed every

* Received for publication March 6, 1920. Published by permission of the Chief, Chemical Warfare Service, U.S.A.

day for eight months, three times suffering severe exposures that caused dizziness, nausea, profuse lachrymation, blurring of vision, gasping, coughing, staggering, and prostration that lasted several hours. Chronic symptoms were muscular weakness, lassitude, congestion of the lungs, irritation of the skin, hoarseness, conjunctivitis, edema of the eyelids and burning urine. There were also periods of irregular pulse that bore no relation to heavy exposures. The appetite was decreased after severe exposures but at other times was abnormally increased. During this period his weight fell from 170 to 150 pounds but at the end of five weeks after change of occupation he weighed 160 pounds.

The principal variations from this picture among the other men were chronic vomiting, diarrhea, frequent urination, persistent coughing, spasmodic pain in the respiratory muscles, cold perspiration and chronic dull headache; certain of the men also complained of mental disturbances though these may have been due to the weakened physical condition. These symptoms were of varying severity in the different subjects. In addition to these, certain individual manifestations may be noteworthy. One subject lost 25 pounds in weight in a month and regained 5 pounds in ten days after transfer from the work. Another, weighing 116 pounds in the beginning, lost 14 pounds in five months and regained 6 pounds in five days off duty. One complained of lumbago and chromidrosis, another of a tendency to paralysis of the entire thoracic musculature of the left side along with other rather severe typical symptoms. He also suffered blistering of the face and genitals after more than usually severe exposures. Still another man, who had a quantity of the liquid thrown into his face by an explosion, was blinded for five days, during which time there was some paralysis of the respiratory muscles with a mild degree of opisthotonos. All of these men eventually recovered with change of occupation. There seemed to be no evidence of alteration in susceptibility. While these symptoms resemble closely those reported for other cases of chronic cyanide poisoning, there are, however, some distinctive features, such as the loss of weight, congestion of the lungs and cutaneous manifestations that indicate a possibility of an additional factor.

In connection with these findings, several series of experiments were carried out. First, a series of six dogs was injected with sublethal doses of a solution of cyanogen chloride in 0.9 per cent. NaCl and kept under observation ten to twelve days. These animals lost from 5 to 15 per cent. of body weight. With one exception, they showed listlessness, chronic diarrhea, chronic cachexia, depressed reflexes, conjunctivitis and rhinitis in varying degrees. There was also a tendency to cardiac irregularity. Autopsies showed no macroscopic lesions.

A second series of eight dogs received lethal injections of cyanogen chloride but were previously protected by subcutaneous injections of sodium thiosulphate as suggested by Hunt (11). These animals lost from 5 to 14 per cent. of body weight, showed less cardiac irregularity, greater general depression and greater depression of reflexes than those of the first series, and several showed varying degrees of pulmonary congestion at autopsy. In general, it may be said that the symptoms were much more severe.

A third series, consisting of five dogs and a goat, was exposed to sublethal concentrations of vaporized cyanogen chloride on successive days for a period of two weeks, the periods of exposure varying from thirty minutes to two hours. In a few instances, some of the animals showed convulsions and paralysis during exposure, but none died as a result. Additional symptoms during exposure were irritation and ex-

citement, nausea, vomiting, urination, defecation, lachrymation and salivation. Subsequent developments were muscular tremors, weakness, listlessness, chronic diarrhea, depression of reflexes, tendency to cardiac arrhythmia, conjunctivitis, rhinitis, progressive increase in pulse and respiratory rate. Two dogs were rather severely blistered in the inguinal region. In general, the symptoms were still more severe than in the second series, though less so for any given exposure. There was an average loss of 13 per cent. of body weight for the dogs and 17 per cent. for the goat. All of these animals showed a severe degree of pulmonary congestion at autopsy.

Another series, already reported (10), was now exposed under the same conditions to sublethal concentrations of vaporized hydrocyanic acid, with resulting less severe symptoms during exposure than for the corresponding experiments with cyanogen chloride. During the experimental period of ten days there was a loss varying from 2 to 11 per cent. body weight, most of which occurred from the third to the fifth days, with no particular change thereafter, while two animals gained slightly during the remainder of the period. These facts indicate that either there was developed a certain degree of tolerance, or else the early loss was due to some unrecognised factor. In all the other series any loss of weight was progressive.

Animals subjected to lethal administrations of the two substances die with much the same train of symptoms. These facts, together with the findings in the cases reported and the results of the experiments, indicate that, while the principal effects of poisoning by cyanogen chloride are much the same as those from hydrocyanic acid, there are certain points of difference: the loss of weight is greater from cyanogen chloride, the increase in heart rate is greater, there is conjestion of the lungs, depression is more pronounced and there are greater muscular disturbances. It has been suggested that this difference in action of the two compounds is dependent upon the presence of chlorine in the cyanogen chloride. In this connection may be mentioned another series of experiments previously conducted, in which goats were exposed to what had already been proven to be lethal concentrations of cyanogen chloride. These animals survived the usual danger period of a few hours for such exposure, but died in from one to three days with severe pulmonary congestion resembling that resulting from exposure to chlorine.

Summary and Conclusions

From the similarity of experimental results and clinical pictures of poisoning from cyanogen chloride and from the more common cyanides, it may be concluded that the chronic effects resulting from the former are due to chronic cyanide poisoning.

It is probable that certain symptoms noted as resulting from chronic poisoning with cyanogen chloride may be due to the presence of chlorine.

The chronic symptoms of cyanogen chloride poisoning are more severe than those resulting from the more common cyanides.

Severe symptoms resulting from a single large dose of common cyanides may not be followed by any chronic symptoms, while a single large dose of cyanogen chloride may result in death as a termination of chronic symptoms.

BIBLIOGRAPHY

1. Cohen, B.: Cited in editorial on Poisoning by Prussic Acid Fumes. Brit. Med. Jour., 1916, **2**, 464.
2. Wilkes, G.: Lancet, 1904, **2**, 1058.
3. Souwers: Phila. Med. Times, April 27, 1878.
4. Boddaert, A.: L'Empoisonnement chronique par l'acide cyanhydrique. Ann. Soc. de méd. leg. de Belg., 1897–1898, **9**, 238.
5. Collins, J., and Martland, H. S.: Disease of the Primary Motor Neurones Causing the Clinical Picture of Acute Anterior Poliomyelitis: The Result of Poisoning by Cyanide of Potassium. Jour. Nerv. and Ment. Dis., 1908, **35**, 417.
6. Schlegel: Inaugural Address, Berlin, 1891, cited by Sollman.
7. Koritschöner, M.: Ueber die Blausäure und ihre Wirkung auf die Tuberculose der Lungen. Wien. klin. Wchnschr., 1891, **4**, 48.
8. Winternitz, M. C.: Anatomical Changes in the Respiratory Tract Initiated by Irritating Gases. Mil. Surgeon, 1919, **44**, 476.
9. Führer, H.: Die Blausäurevergiftung und ihre Behandlung. Deutsch. med. Wchnschr., 1919, **45**, 847.
10. Reed, C. I.: Chronic Poisoning from Hydrocyanic Acid. Jour. Lab. and Clin. Med., May, 1920, **5**, 512.
11. Hunt, R.: Zur Kentniss der Toxikologie einiger Nitrile und deren Antidote. Arch. internat. de pharmacod., 1903–1904, **12**, 447.

WELFARE IN FACTORIES AND WORKSHOPS*

A. M. ANDERSON, C.B.E.

His Majesty's Principal Lady Inspector of Factories

Introduction

A DEFINITE and considerable advance towards national control of the means of welfare of factory workers has been achieved during the Great War, by legislation as well as administration based on ideas and demands of the workers and on broadening views of employers and the nation.

The advance in the factories is, in detail, not strikingly different from results achieved in individual factories in many instances before the war, of which for long years there have been interesting records, official and other. Indeed we have evidence stretching as far back as the origins of factory laws, of separate, scattered efforts towards constructive means of personal welfare in factory life.

The recent new endeavours to apply principles of psychology and physiology to regulation of the conditions of personal labour in manufacturing industry carry back our thoughts to the reminder of Robert Owen to his brother manufacturers in 1813; that, just as power-driven machinery (then a recent innovation) was improved by being carefully tended, kept clean and well supplied with oil, so the far more complex, living mechanism of the worker would be greatly benefited if carefully studied and well treated. Although far more than a motor, the human worker is yet, in his capacity of producer of mechanical energy, a highly delicate motor, needing very specialised handling in the way of chemical alimentation and rhythmical activity or motion (1).

The vital change that this war has wrought is in the sudden shaking together of isolated movements into the beginnings of a co-ordinated, associated effort, and in the bringing to birth of a wider, general perception of the value of sustained application of method, science, and above all imagination, to the socially constructive reforms called for in industrial life. Not only is it freshly seen that welfare, like health, is one whole, being a vital function of life itself, including the joys of work as well as of rest, and that service in industry is national service, but, for the first time perhaps, there is some vision of the size and radical character of the work to be done. The welfare of industrial and labouring workers is seen as no small portion — owing to the many millions of persons concerned — of the whole field of human welfare; as well as a matter of multifarious detail in improved conditions of daily life inside and about our factories.

Some confusions and even opposition have no doubt arisen through a somewhat indiscriminate application of the term "welfare" to two distinguishable though interrelated things, the state of welfare (well-being and welfaring) of the persons concerned on the one hand, of which each person has his own view, and the particular measures or means tentatively and experimentally (and of course with fallible human factors) adopted to bring about that state of welfare in a rapidly changing condition of industry. These confusions and difficulties can however be cleared away, as progress is made in understanding what

* Reprinted in part from the Annual Report of the Chief Inspector of Factories and Workshops, Great Britain, for 1918.

really is afoot, and as experimental measures are more fully tested and sorted into their proper place in accordance with the desires and aspirations of the persons concerned.

The fundamental term or notion "welfare" cannot be strictly defined for in some degree its content changes with the content of life generally, and it is indeed as complex as personality. While freely admitting that varied ethical and psychological as well as physiological and economic elements are involved, and that in the words of an American economist: "Welfare comprehends and represents all things of reasonable and rightful desire" (2), the immediate legislative and administrative problem is to discover and apply in the existing (or attainable) "conditions and circumstances of employment or the nature of the processes carried on" in factory life, those arrangements and material surrounding conditions which will best conduce to the personal health, efficient working and welfare of each and all the workers. Suggestions have been made, by those dissatisfied with some of the recent voluntary measures for securing welfare in munition factories, that the word should be replaced in its technical use by some other, free from those associations. In view of the stable meaning of the term in the English language, from Chaucer onwards, that would seem to be a mistake. The word is bound to stay with us and its use in the Act of 1916 is in harmony with tradition, while its application in practical measures is surely safe in the hands of expert administrators open to continual public criticism, basing, as they certainly will do, their work on the considered recommendations of joint standing industrial councils representing employers and employed, as well as of the various scientific research committees recently appointed.

While recognising that all conditions — including hours and pauses for rest and due prevention of over-fatigue, safety and general sanitation, special regulation of dangerous trades and adequate remuneration, as well as the newer methods of securing personal hygiene and well-being — are part of the means of welfare for factory workers, it is with the last named class of measures, tried on a steadily widening scale during the war, that this chapter is particularly concerned. More especially it has to show the position brought about by the new requirements being made in Orders under the Police, Factories, etc. (Miscellaneous Provisions), Act of 1916, Section 7. These now take on a fresh significance through the natural termination of temporary, special war measures, administered in munition factories by the Welfare Department of the Ministry of Munitions, and by the Factory Department, through "Emergency Orders" in both munition and non-munition factories.

Development of Welfare

Before the war it could be truly said that "the whole framework of modern life is economic," and that "it began with machinery and steam and had been built up within a century" (3). Then, isolated measures of welfare flourished here and there in factories, as expression either of the goodwill of individual employers to their workers or of their perception that good conditions paid, in better results. Then, too, the Factory Acts, and action and advice of the factory inspectors, laid the foundations of general hygiene and safety on which personal welfare can be (and often was) voluntarily built up although often totally lacking — as may be seen yearly in past annual reports of the work of the department.

During the war, and to a rapidly increasing extent, the whole national framework passed from an economic to a non-economic footing. Emergency measures and requirements to safeguard health and welfare be-

came urgently necessary, not only to counterbalance the inevitable interference with some of the legislative and customary limitations that arose mainly during the economic nineteenth century, but also to husband and promote the vital forces of workers under a previously undreamed-of strain of intensified national production. The abnormal conditions of mobility of personnel as well as hours of labour, and intensified output, called for special temporary measures, as tens of thousands of workers — not only men and boys but also women and girls — had to be transported to centres very hastily prepared for them. Many of these temporary measures, and some of them outside the main stream of the work of the Factory Department, lost their significance almost at the signing of the armistice or survive only in a modified form for the demobilisation period. Those, however, that belong to the safeguarding of permanent features of factory production and that are built upon the substructure of the Factory Acts, remain. They rapidly sprang into life and activity through recognition of the fact that the safety and welfare of the commonwealth were absolutely dependent on the safety and welfare of the industrial worker as the mainstay of the fighting forces of the Crown. They no doubt owed their effectiveness and rapid development during the war to previous social and administrative progress. Their continuance, however, in Welfare Orders and other ways is not simply a legacy of the war; it is due rather to an apparent ripeness of time for a new humanising of the whole condition of production for the manual worker.

We have learnt during the war that the kind and main aims of production have their influence as well as hygienic considerations in securing means of welfare for the industrial worker, and to recognise that "wages alone cannot adequately award those who serve the State in time of need." The future of this welfare movement will depend as much on imaginative construction as on the still indispensable production of ample material wealth.

The first definite official steps towards securing welfare conditions for factory workers in the revolutionary conditions that arose out of the war, in both munition and non-munition industries, were the appointment of: (a) the *Women's Employment Committee* (jointly by the Home Office and Board of Trade); (b) the *Health of Munition Workers' Committee* (by the Minister of Munitions with the concurrence of the Home Secretary); (c) *The Central Control Board* (Liquor Traffic), with its powers to establish and maintain (by themselves or through agents), refreshment rooms for the sale or supply of refreshments, for, among others, "persons employed in any particular industry" — all in the summer of 1915.

The task of the first committee (a) was to consider the situation arising out of rapid substitution of women for men, and the measures to be taken not only for mobilising reserves of women labour but also in preparation for social problems certain to arise — especially in housing, transit, and local need for canteens, patrols, recreation, clubs, care of the sick, etc. From their enquiry and recommendations sprang, early in 1916, the appointment of the first *Local Advisory Committee* (numbering upwards of forty, chiefly in great munition centres) co-ordinated by the *Central Advisory Committee*, under the chairmanship of Mr. Cecil Harmsworth. These were appointed by the Ministry of Labour in conference with the Home Office, the problems being mainly of welfare outside the factory connected with mobilisation of women and girl labour. They did good work in stimulating and co-ordinating the various voluntary and local efforts, until other means and measures arose, in the Welfare Section, Ministry of Munitions, in

the Canteen Committee of Central Board of Control (Liquor Traffic) and in governmental billeting administration. Some of these local committees were later absorbed into the system of representative local advisory committees attached to employment exchanges nominated usually by associations of employers and workers. These were, in their turn, largely concerned with re-settlement of labour on demobilisation, military and civilian.

The task of (b) the *Health of Munition Workers' Committee* under the chairmanship of Sir George Newman was "to consider and advise on questions of industrial fatigue, hours of labour and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops." This was not in any way an administrative committee, but advisory, and it proceeded by investigation, in co-operation with the Ministry of Munitions and the Factory Department. It issued a series of invaluable memoranda and reports which have not only affected administration and public opinion in this country but have proved of international value. Their issue came to an end with the publication of a handbook on the *Health of the Munition Worker* in October, 1917, and a final report on *Industrial Health and Efficiency* in April, 1918. Before the end of 1918 a research board was set up jointly by the Department of Scientific and Industrial Research and the Medical Research Department (National Health Insurance), to consider and investigate the same class of questions throughout the field of industrial employment, known as the Industrial Fatigue Research Board.*

(c) *The Central Control Board* (Liquor Traffic), appointed in June, 1915, was the government authority set up by an Order in Council under the Defence of the Realm Consolidation Act 1914 for the purpose of increasing directly or indirectly the efficiency of labour in any specified areas. They had power given them not only as regards establishment and maintenance by themselves or through agents of refreshment rooms but also to acquire compulsorily any premises or interest therein, to provide or authorise provision of entertainment or recreation, arrange for postal and banking facilities, and to appoint their own inspectors with powers similar to those of inspectors under the Factory and Trade Board Acts. In co-operation with the Factory Department and the committees above described, as well as with the Welfare Department later set up by the Ministry of Munitions, these powers were, with immense gain to industrial workers (munitions and other), exercised by the Canteen Committee of the Central Control Board and carried further by the Food Section of the Ministry of Munitions. The canteen movement, with very important aid from Y. M. C. A., Y. W. C. A., Church Army and other voluntary organisations, has extended enormously during the war. . . . Whereas before the war there were barely 100 regular factory canteens (as distinguished from many more messrooms) there were probably well on to a thousand working or in process of building before the end of 1918 and no important munition factory was without a canteen.

Much more direct and continuous co-operation, in matters of internal welfare in munition factories, than in any of the above cases was effected between the Home Office and the Welfare Department of the Ministry of Munitions when the latter was set up at the beginning of 1916 by the Minister, Mr. Lloyd George. The pioneer work of Mr. Seebohm Rowntree, the first director of the Welfare Department, was avowedly based on exhaustive reports by the factory inspectors on every large munition factory,

* Terms of reference: "To consider and investigate the relations of the hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers."

which showed the size and needs of the factories, particularly as regards women and girls, the basis as regards conditions under the Factory Act on which welfare conditions might be built up, and which made definite recommendations as to the kind and extent of welfare work that seemed requisite in each case. In due course officers were lent from the Factory Department, Dr. Collis as Director in succession to Mr. Rowntree in 1917, and Miss Squire, O.B.E., as Director of Women's Welfare in 1918, and under their direction extensive plans were begun and officers appointed for development of outside welfare of munition workers, more especially for recreation and maternity and infant welfare. . . .

Lastly reference must here be made to the valuable and important outside welfare work in connection with housing and lodging of munition workers effected first by the Hostels Department of the Ministry of Munitions and later, from 1917 onwards, by the Billeting Board set up by the government. This lies outside the direct concern of the Factory Department but inevitably good progress in this direction had an intimate connection with problems of feeding and general care of the health of the factory worker.

During the war while the new departments set up large staffs for the new kinds of duties the Factory Department remained simply expert advisers as regards conditions in factories without any net increase in staff. Many of the men inspectors either joined the forces of the Crown or were lent for special duties in other war-time departments. On the other hand, additions were from time to time authorised to the women's branch by the appointment of temporary inspectors who gave us much valuable help. They numbered, for general inspection, fifteen salaried and four voluntary. . . . For the special technical help needed in administering the first-aid and ambulance orders, appointment was further authorised by the Treasury of three specially qualified women, and they have been at work during the greater part of 1918.

Orders under the Act of 1916 and Explanatory Pamphlets

The first Welfare Orders made under the Act of 1916, in October, 1917, came into force on December 1st of that year and they tested in an interesting way some of the varied methods of applying the welfare provisions allowed for in Section 7 (3) (a). One, the order affecting factories in which the *manufacture of tin or terne plates* is carried on, applies to a distinct class of factories with hitherto a rough and heavy class of work, and requires the provision of several means of health and comfort: protective clothing in pickling and wet processes (all persons), with simple cloakroom (all women and girls), messroom and washing facilities (all persons), under responsible supervision for maintenance and effective use. Another, the order requiring conveniently accessible supply of wholesome *drinking water* in every factory or workshop employing twenty-five or more workers, secures a fundamental condition of health and well-being for every description of workplace under the Act in all those cases where special arrangements for it are most necessary, and liable, if difficulties arise in getting the supply, to be sometimes neglected. Another, the order in regard to *ambulance and first aid* arrangements at *blast furnaces, copper mills, iron mills, foundries and metal works*, applies modern remedial and preventive first aid in case of injury by accident for all workers in large classes of factories where such accidents are most liable to arise in large numbers.

This last named class of provision for welfare was extended towards the end of 1918, by another order, to *saw mills and factories in which articles of wood* are manufactured and where also risk of accident is

widespread and large numbers of workers, in normal times chiefly male, are concerned.

Two other orders, made early in 1918, apply in two industries to a special class of process where the nature of the work carried on is "such as to require special provision to be made for securing the welfare of the workers"; these are the processes where *bichromate of potassium or sodium* are used in (a) *dyeing* (other than job dyeing) and (b) *tanning* by the "*two-bath*" *process*, and the welfare measures required include: protective clothing, first aid, suitable accommodation for clothing put off during working hours and arrangements for drying it if wet, simple messroom arrangements and washing facilities, under responsible supervision for maintenance and effective use. In a third special group of industry: manufacture of *glass bottles or pressed glass*, similar welfare measures (omitting first aid) are required, and the supply of wholesome drinking water is required whatever the number of workers, as this is a branch of industry where, great heat being inevitable, the need is always paramount.*

Lastly an order made in July, which came into force in August, 1918, applies to a particular group of munition factories, those engaged in the process of *turning or machining shells or shell bodies*, a requirement as regards female workers of facilities for sitting, "so as to enable them to take advantage of any opportunities for resting which may occur." . . .

The power given in sub-section 7 (9) to the Secretary of State to extend the scope of the whole section to matters additional to those enumerated in 7 (2) has been exercised and provision of rest rooms may now be required since April 16, 1920.

. . . As yet no direct requirement has been made by order for welfare supervision of workers, only incidentally for the care of messrooms, washing facilities and cloakrooms. Nor has any order yet required the setting up of a canteen, or provision for preparing as well as heating and taking of food. The Home Office has however prepared the way for requiring canteens, where needed under peace conditions, by issue in 1918 of a pamphlet on *Messrooms and Canteens at Small Factories and Workshops* (4). . . .

The pamphlet on *Protective Clothing for Women and Girl Workers*, issued in 1917 (5), by its thorough, classified tabulation of industries and processes, showing the need in each instance for typical kinds of protective clothing, and the reasons, makes the future steady extension throughout factories of this kind of measure for health and welfare a comparatively simple matter. The almost universal use of suitable uniform or protective clothing during the war throughout munition factories, affecting hundreds of thousands of women and girls, has inaugurated a new point of view and habit in this matter. . . . Orders where they require provision by the occupier of protective clothing simply enforce on all factories in a trade or process what is already customary in some of them.

A far wider pamphleteering piece of work in aid of development of welfare was actually undertaken and carried through by the Home Office, in 1916 and 1917, when the need was paramount for the replacement of men by women on a large scale in factories to set free as many men as possible to join the colours. The foundations of this work were laid from the spring of 1915 onwards when conferences between employers and employed were arranged, in a number of non-munition industries, under the chairmanship of factory inspectors, to negotiate and lay down in signed agreements the conditions under which women and unskilled labour might be in-

* Since the above was written orders for various welfare requirements have been made in the following industries: preserving of fruit; oil cake mills; laundries. Orders are in draft for: gut scraping; manufacture of hollow-ware and process of galvanising; gutting, salting and packing of herring.

troduced into men's skilled and semi-skilled operations. As these progressed, and women came in increasing numbers, the need of safety, health and welfare precautions, adapted to their needs and frequent inexperience, became evident and in some cases were suggested in the agreements. Then to assist and extend the practice of substitution it became clear that published records of the actual substitution, process by process and occupation by occupation, would be of great practical value to employers. There followed the rapid publication in 1916 of a series of pamphlets on the substitution of women in industry for enlisted men, prepared by the Home Office and Board of Trade, and a prominent feature in these was the indication of advice as to arrangements necessary for the health and welfare of women and girls in processes and surroundings entirely new to them. A new edition embodying the results of experience was necessary at the end of twelve months and the second edition was published in December, 1917, covering additional trades and bringing the total number up to twenty-seven, including many thousands of processes against each of which was indicated the main precaution, if any, specially necessary. Although much further substitution of women for men in increasingly heavy occupations (involving increased vigilance as to necessary safeguards) followed in 1918, in the military crises of that year, the new occupations were mainly of a labouring type, not skilled processes, the immediately practicable limits of which had already been attained. Thus the second edition of twenty-seven pamphlets (6) covering all kinds of textile and non-textile industries remains a permanent record, both of the remarkable extent of substitution effected and of typical kinds of welfare precautions then deemed necessary and practicable. Many of the latter provisions obtained legal force, since special emergency orders were requisite to allow deviation from normal Factory Act requirements as to hours and times of work, and to these the Home Office attached — as it did to the General Munitions Orders — conditions as regards welfare.

When speaking of the new Home Office method of spreading knowledge and advice about welfare during the war by means of pamphlets, it should be recalled that from the autumn of 1915 onwards the Health of Munition Workers' Committee were rapidly issuing their valuable memoranda on different branches of welfare work, and that these in addition to their appeal to the most thoughtful employers reached a wide, general, reading and thinking public, to whom the brief direct and practical instructions of the pamphlets would be far less interesting than they were to employers. Thus on all important sides the new welfare movement was winding its way into ever widening channels.

Returning to the most recent work of the inspectors under the Act of 1916 in the year 1918, many studies and enquiries have been or are being made, and reports have been submitted in 1918 as regards a wide range of non-munition industries. Some of the proposals and suggestions run on similar lines to those indicated in orders already made, some point to the possibility of new experimental measures under the powers given by sub-section 7 (2) of 1916. . . .

Further Welfare Orders that are in preparation or actually in draft in consequence of enquiries and reports relate to the following industries: the hollow-ware and galvanising, and gut scraping industries. Reports are under consideration in the india-rubber clothing and fish-curing industries. Enquiries are generally in progress in various textile industries, aerated water factories, and throughout all these and other industries it is clear that a varying proportion of the factories are already

introducing some of the amenities that will in due course be made applicable throughout.

Observance of the Orders

Reports from the inspectors show marked progress on the whole in observance of the orders already made and a widening and deepening interest, particularly as regards the larger factories, among employers and workers in general betterment of hygienic and social conditions of welfare. The interest taken by many employers in the terms of orders not yet applied to their industry is great. They ask for copies and voluntarily comply, some because, they say, it is only a matter of time before the order will apply, others because they wish to do more than the law requires. "Even small firms have made some attempts in this direction" in some parts of England, although in them nearly the whole work of co-ordination yet remains to be attempted, and in some directions "progress is by no means as general as the inspectors would like to see it" (Mr. Wright and Mr. Williams). In the small clothing factories and workshops, largely occupied by Jews, in great centres such as Leeds and East London, there is a far lower standard of personal welfare than in the great clothing factories where much good work has been done and often a high standard has been attained by voluntary action of the employers. In the smaller workshops, both Miss C. Smith and Miss Taylor point to the practical necessity of grouping occupiers (and this is necessary, generally, for tenement factories) as regards responsibility for messrooms, cloakrooms, etc., under common provision for superintendence and maintenance. Associations of employers all over the kingdom are progressing in careful study of the whole question and stimulating their members to make practical experiments. Workers are becoming "keenly alive to the value of improved and more comfortable conditions and also to the powers of the Secretary of State to make Orders" (Miss Slocock), and in many of the larger works "Welfare Committees have been formed to deal with such questions as lavatory and cloakroom accommodation, canteen arrangements, rest rooms and library" while often "a social or amusement committee arranges for concerts, etc., to be given," and where the arrangements are "left in the hands of the workers' elected representatives these schemes are generally successful" (Mr. Jackson). Boys' clubs have been established in some of the most progressive larger works, in which, in addition to the usual "recreation and educational schemes, there are classes for physical culture and for ambulance classes." In some cases a medical officer as well as trained nurses are engaged in steady health work additional to administering first aid, and while the appointment of a superintendent or supervisor of all the welfare work of a factory is far more general in the case of women and girl workers, still the appointment of trained men to look after the general welfare conditions for men and boys has begun and is progressing. In the South-Western Division, less highly industrialised than other divisions of the kingdom, the existence of these male officers is reported in thirty factories, most being whole-time officers. In some cases they visit men and boys who are ill, "consult with them as to difficulties in their work and bring any grievance to the notice of the management, obtaining lighter works for boys who are too weak for their assigned tasks . . . some of the supervisors engage all boy labour and others are responsible for securing compliance with certain requirements of the Acts, *e. g.*, hours of work and certificates of fitness. They act in close association with works committees where such exist" (Mr. Rogers). In a large factory in the Midlands, with excellent welfare conditions, "conciliation

boards have been formed to deal with disputes as soon as they arise," the result attributed to this is "absence of any labour trouble in the factory." (Mr. Harston). . . .

In Lancashire, in the highly organised cotton textile industry, with a primitive, traditional standard in arrangements for personal hygiene . . . neither manufacturers' associations nor operatives' unions appear before the war to have concerned themselves with the fundamentals for welfare, first authoritatively enumerated in the Act of 1916. Miss Pease comments on the valuable enlightenment in this matter effected when 1,300 women cotton operatives were recruited for a large, well-provided munition factory, in a district, where she had "found women taking their meals while sitting on the floor of a gassing room and apparently liking it." She says: "Several large firms have now planned extensive improvements though prevented from carrying them into effect under wartime conditions." . . .

In Ireland where there have long been several factories with remarkably good welfare arrangements there has been little progress to note in 1918, or preceding years during the war, outside the few munition factories — now closed down. In certain controlled works no serious attempt was made to fall in with advice from the Welfare Department of the Ministry of Munitions as to conditions of welfare and the general tendency has been to await the application of legal welfare.

In the dressmaking and allied trades, in the special West London district, Miss Stevenson reports a marked change in the outlook on welfare measures, especially as regards workrooms connected with large retail shops. The agreement, chiefly as to hours, recently made has helped to organise the trade on more human lines; in several instances shop committees have been set up through which suggestions and grievances can be brought to the knowledge of the management. She says:

> Welfare work in West End establishments is hampered by lack of proper buildings. Nearly all the large firms have schemes for rebuilding which have been stopped by the War, but which are now due to be carried out. These schemes almost invariably include canteens, recreation and rest rooms. In my opinion the recreation rooms are essential, as in London almost all the workers wish to remain in the canteen for dinner and it is impossible for accommodation to be provided for all at once. The meals must therefore be allowed in different parties and if one hour is given for dinner, in order to make room for others the workers must either return to the workrooms or go out into the street, both equally undesirable. In some cases this difficulty is overcome by allowing only half an hour for lunch, but there is no doubt that at least three-quarters of an hour is advisable as a dinner interval.
>
> There is great need for efficient welfare workers in these large West End houses. The present system consists of each section being in charge of the fitter, who is an autocrat in her own department and brooks no interference. The state of the rooms, therefore, varies according to the temperament of the fitter — being clean, if she has theories on the subject of cleanliness, but not otherwise; warm, if she likes heat and so on. She engages her own workers, so that it is difficult for the firm to ascertain whether, for example, certificates of fitness are being obtained, or if the young persons are attending school regularly. The general arrangements as to cleaning and upkeep of messrooms, passages, lavatories, sanitary accommodation, etc., are in the hands of charwomen and cooks, and are not under any one definite person's direct supervision, unless it be the workroom manager, who is content so long as he receives no direct complaints. The result is that the messrooms are gloomy, dingy apartments, and the sanitary and lavatory arrangements are old-fashioned and only fairly well kept. Apparently no progress has been made in the last 10–15 years. In one instance, where an experienced welfare worker has been appointed, a great change is evident. There is co-ordination throughout and the general standard is rapidly being raised. It is to be hoped that, when the other firms rebuild, they will appoint really efficient people to superintend the comfort of the workers, or however well they start, they will gradually lapse again into the same unsatisfactory state.

The widespread network of governmental control, financially and otherwise,

during the war, of a great number of staple industries — not previously thought of as connected with munitions of war — has meant the general introduction into them, through visits from welfare officers of the Health and Welfare Section of the Ministry of Munitions, of modern ideas on betterment of conditions surrounding workers. Even where little has been actually attempted the ground has been in a sense dug and prepared, and even seed sown, to a wide extent. Many of these welfare visits took place in the later stages of the war when material and labour were hardly available for structural alterations. The Factory Department is none the less strongly reinforced for its coming activities under the Act of 1916, by this preliminary crusade of ideas. Among many important industries affected in this way may be mentioned paper making, leather equipment, asbestos manufacture, soap making with its incidental glycerine production, oil seed and cake making, clothing, in addition to many branches of textile industries. . . .

In Scotland Mrs. Shaw says that "the belief in social betterment which is permeating all classes has been definitely helped by the mixture of classes in the factories. The middle class worker has demanded a minimum of good conditions, and everywhere the pressure for hygienic betterment is increasing and is being recognised."

A large special chapter might be written on the varied forms of recreation and entertainment developed under the fostering care of the Canteen Committee (Central Control Board) as well as by individual enterprise of firms and works' committees in munition factories during the war. In some of these a hall, equipped with a stage, artists' dressing rooms and a buffet, is provided for entertainments, lectures, dances and so on.

In a Glasgow engineering factory red blaize tennis courts are provided in which the employees play on Saturday afternoons, bringing their tea with them which they make in the canteen left open for their use. At this works there were also dramatic and choir classes in the winter evenings. An interesting innovation at one of the Glasgow east-end textile mills has been the inauguration of a series of lectures by the Works' Committee, attended during working hours: the syllabus of lectures included such subjects as "Quality" and "Discipline." Workers are paid for the time spent in attendance at the lectures. (Miss Vines.). . .

Certain engineering firms have acquired small homes on the west coast, which they maintain for those of their workers who become run down or require a rest and change. One progressive firm has arranged week-end camps for their apprentices, and the boys are given simple lectures on botany and geology when away. In isolated works in rural areas employers have recognised the necessity for recreation, and in connection with one large factory in a remote village in Scotland there is a cinema run by a small Committee of the workers, an angling club, a tennis court, and bowling green. The cinema is particularly popular and always well patronised. A firm of engineers on the Clyde gave up a considerable area of waste ground, previously unused, round the works, to their workers for allotments or other purpose. The experiment proved an unexpected success, the plots were sedulously cultivated, vegetables and flowers grown, and a tennis court constructed by the men in their own time. A successful flower show was held at the end of the season, and several men who previously had had no opportunity of cultivating any ground whatever, living in Glasgow tenements as they did, maintained that they would not give up the allotment now on any account, they had no previous idea that the growing of a few vegetables or flowers could give so much interest and pleasure. (Mr. Wilson.)

One large firm employing several thonsand hands has built and run a fleet of motor buses to carry their workers to and fro within a ten-mile radius as the train services did not meet all their requirements. They also purchased an estate within easy access of the works and built houses on it which were let to the workers. A technical society with 750 members, owning a free library, was established in connection with the works and lectures on technical subjects given at frequent intervals. Eleven acres of playing fields were provided, and athletic, hockey and football clubs formed. There were organised two works bands, an orchestra, a choral society and two cinema theatres, and when night shifts were worked the services of artistes from the Birmingham theatres were obtained. The firm also provided eleven pianos and seven billiard tables for the entertainment of the staff.

Another firm in addition to providing a well-equipped surgery, has started a dentistry department in which workers are given advice and treatment at special rates. (Mr. Harston.)

The detailed results actually achieved at the close of 1918 in factories as reported by the inspectors are as follows:

Drinking Water. — The inspectors generally show that as regards adequate supply of wholesome drinking water the requirement of the order in most factories in large urban centres was already forestalled, and that it was mainly in getting the further details carried out that their work there lay. In places like Birmingham and Coventry, in the South-Eastern Division and in some towns of Scotland and elsewhere, employers showed a preference for the upward jet system. The workers are not unanimous in liking this method: some do so but others have a prejudice against using it still to be overcome. Mr. Wilson reports a considerable extension of installation of such "bubblers," and lays stress on its being the only really suitable method in all trades that are essentially dirty, such as oil refining, grease extraction, fish-manure making, where it is practically impossible to keep a drinking cup or receptacle free from contamination; to a less but also important extent this consideration holds good in hot and dusty trades. In cotton mills, Mr. Jackson points out that the point of supply was very generally out in the yard, and that clearly this is not suitable for workers coming, especially in cold or wet weather, from heated rooms and sheds. In such works also a problem has arisen as to what constitutes an adequate number of points of supply, for, it is pointed out, a simple standard of numbers does not cover the whole problem where circumstances vary widely. Provisional agreements are being made and carried out so as to test this point. "In one case of a large iron works where over 1,000 workers were employed, water was supplied from one tap near the gate, and an almost continuous stream of boys bearing buckets to the different parts of the works was the result." (Mrs. Shaw.)

The case of the country factory is generally very different from the town factory, and in rural districts there have been, relatively, both much more work to do and difficulties to overcome than in urban districts in England and Scotland. In some parishes the only source of supply is still the village pump. . . .

The reports of the inspectors show much pre-occupation with regard to use of receptacles, buckets or other vessels for supply of drinking water to different parts of a factory. Most consider them to be always objectionable and not permissible at all where there is heat or dust. Generally, opposition has been expressed by employers and workers to the idea of a common drinking cup as unhygienic. Most workers prefer to use their own cup.

Canteens and Messrooms. — Under this heading far more has to be said of progress by voluntary action and under special war-time arrangements . . . than has yet been effected by orders under the Act of 1916. It does not fall within the scope of this report to give a review of the great work accomplished by the labours of the Canteen Department of the Central Control Board . . . in controlled munition factories — and later by the Food Section of the Minister of Munitions with the help of grants in aid of building from excess profits. Reference to it cannot, however, be omitted here for not only was it probably the most decisive factor in enabling the munition workers to sustain the fatigue of their intense toil, but it has effected a changed outlook throughout industry on this question of arrangements for meals on or near factory premises, and in many cases with improved dietaries for workers. The Home Office insistence from the outset in its emergency orders, general and special, and for

non-munition as for munition factories, on the obligation to provide proper and suitable means for heating and taking meals on *night shifts*, has also had great effect. Miss Lindsay says that in the North-Western Division practically all the firms went beyond providing means of heating food and provided proper cooking facilities as the workers all preferred it. "It is usually only lack of suitable opportunity which has made the worker apparently content with warmed-up food. This applies particularly to the night shift when appetite is not so keen." . . . Miss Taylor found on consolidating her information that 84 per cent. of clothing factories in Leeds, employing 100 or more persons, have generally good messroom accommodation. "Taking the trade as a whole and including the large number of quite small factories, 64 per cent. of the women are employed in factories which have messroom accommodation." . . .

Considerable progress was already reported in 1917 as regards compliance in a simple homely way with the messroom requirements of the order applicable to tinplate works. Some firms, however, submitted large plans of construction with high class arrangements under the scheme for application of excess profits. Difficulties followed through the war-time shortage of materials and labour which greatly delayed progress. Mr. Rogers says: "The majority of firms have either complied fully with the order or have provided temporary accommodation, but some have done little if anything and action is being taken to secure compliance." Similarly Mr. Wright records that the order applying to factories in which bichromate of potassium or sodium is used "has been well received and no difficulties have been met with in its application." In the glassworks good progress is also being made, the emergency order having already made permission to employ women at night conditional on provision by the occupier of suitable means for preparing and taking meals.

In brickworks where provision of messroom accommodation was required among other welfare measures under the emergency order allowing employment of girls under 16, Miss Meiklejohn says that the arrangements are sometimes far from satisfactory and that the reason is in the intermittent employment of the girls. One or two firms, however, have made good arrangements which have been well used; "others have done nothing beyond the building of a very small messroom with a fireplace and without any facilities for preparing meals."

Miss Slocock gives a pleasant account of the pains successfully taken in a small, old woollen mill, in the country outside Bradford, to give workers who stay for meals good food in comfort.

An old low mending room, with the use of lots of white enamel paint and addition of extra windows, has been made into a most excellent canteen with a kitchen for light refreshments at one end and small rest rooms for men and women at the far end. The dinners are sent down daily ready cooked in vacuum containers from the main works and are said to arrive in excellent condition and very hot. All the 140 workers take breakfast in the canteen which is fully equipped, and quite fifty take porridge every morning. One hundred and thirty stay to dinner, a very large proportion taking the full dinner. Tea is taken round to the workers during the afternoon. Washing accommodation with hot water laid on is now (in 1919) being installed in the factory and numbered pegs for clothing for each worker. . . . The occupiers are very good in allowing other manufacturers to see what they have been able to accomplish. . . .

Protective Clothing and Cloakrooms. — The present position in this matter somewhat resembles that just indicated as regards messrooms. The first administrative step was taken long ago by the Home Office when regulating dangerous and injurious trades, and many of the special codes laid upon occupiers the obligation to protect the workers by overalls, etc.,

against poisonous or irritant dusts, excessive wet and (as in aerated water works) against injury by accident. Factory inspectors sometimes further secured, by persuasion of employers, protective clothing for women exposed in various processes to wet or dirt. A new outlook as regards widespread equipment of women and girls with suitable working clothing, and the necessary consequential cloakroom accommodation, was, however, introduced during the war by their universal provision in vast national munition factories and very general similar provision in great controlled munition and allied works, under the guidance of the Welfare Department of the Ministry of Munitions. Since approximately 100,000 women and girls have been for a considerable period used to the comfort and convenience of trim and cleanly protective clothes as a part of working equipment the situation is bound to be changed, as their own view is, when they return to their pre-war occupations. The thorough survey of the industries and processes in which typical forms of protective clothing are requisite, given in the Home Office pamphlet on *Protective Clothing for Women and Girls*, issued in 1917, turns the whole new attitude to practical issues by putting into the hands of the enlightened and well-disposed manager and employer a simple, direct guide to the best way of falling in with the new demand of his women workers for personal working equipment. If he wants more, or more concrete, guidance, he has only to apply to one of the lady inspectors to be shown sample forms of clothing for the typical kinds of risk or inconvenience to be guarded against. It was noteworthy how great was the interest aroused in this matter by the display on lay figures, at the Whitechapel Exhibition in October, 1918, . . . of the main kinds of suitable clothing for wet, hot, dusty, dirty, etc., and dangerous processes, including exposure to acids, burns, and spark-emitting processes. Both workers and employers gave a great deal of attention to that particular exhibit, furnished by the Factory Department. . . .

In spite of great progress, very much however still remains to be done. As regards textile factories, Miss Meiklejohn's experience in jute and flax factories as follows is similar to that of inspectors in other textile works:

> In visiting the jute and flax works in Dundee district, I have been impressed with the desirability of providing cloakrooms especially for workers in dusty processes. The chief difficulty is the lack of space in existing works. At present workers keep their outdoor clothing in the mill sheds — a few wear overalls and fewer still head coverings. Some employers tried providing protective clothing but the women objected to head coverings probably because they were of too thick material. If there were good cloakroom and washing accommodation it should be possible to raise the standard and to get the workers to wear protective clothing, as I think the two things generally go together. One jute factory (weaving) has fitted up an excellent steam heated cloakroom with washing accommodation (hot and cold water, etc.) in what was formerly an engine room. There is no attendant in charge but the women take a pride in keeping the cloakroom clean and tidy, and it has incidentally had a good effect in raising the standard of the more careless and untidy workers. In a spinning and weaving mill one central cloakroom would not be convenient, as being too far from the different departments, and also because the spinners and weavers do not readily mix. The only other instances of cloakroom accommodation, which I have found in the jute and flax works, are space for hanging clothing between the flats and sanitary accommodation, and in a large weaving shed the provision of cupboards or lockers all round the shed — each weaver having her own locker.

Facilities for Washing. — No order yet governs this matter as a whole, and legal requirements exist only, as of old, in codes of regulation for dangerous trades, under Section 75 of the Act of 1901 (which requires such provision in every factory or workshop where lead, arsenic or any other poisonous substance is used), and recently as a subsidiary clause in the welfare orders

for tinplate works, in certain factories where bichromate of potassium or sodium is used and in factories or parts of factories in which the manufacture of glass bottles or pressed glass articles is carried on.

A remarkable fact, on which more than one inspector comments in 1918, as in many previous years, is that existence of dirt alone as an unavoidable feature in a factory, *e. g.*, in rag sorting, sack repairing, gut scraping, has not yet been recognised by occupiers generally in the past as a ground for fitting up good washing appliances. In fact, as Miss Escreet says, this provision has sometimes seemed to be made by them "in inverse ratio to the need." A very considerable step forward has, however, been taken during the war by the almost universal provision of more or less good lavatory conveniences often with hot and cold water, towels, soap, etc., in controlled and always in national works in which engineering processes are carried on.

As building facilities increase undoubtedly washing accommodation will be made a part of any sanitary re-building schemes undertaken by most firms. . . . There is still a very prevalent idea that a basin and a cold water tap constitute washing facilities. . . . It is true, however, that the hot water geyser is becoming more and more a feature of works lavatories and the provision of soap and towels is common. The most pleasing fact is that extension of this provision from clean trades to the more dirty is beginning to appear. (Miss Escreet.)

Miss Vines commends extension of provision of baths in various works and was glad to find in a large food factory that six bathrooms with cubicles attached were being erected.

Ambulance and First Aid. — A somewhat remarkable reception and widespread welcome has met these orders, from employers, managers and workers. Much had already been organised in many industries for a considerable time before the war, and during the war especially in munition works, in advance of the making of these particular orders. In a great number of cases in 1918 the work of the inspectors has lain in application of the details rather than the principles of the orders. The advice as regards methods that the technically trained first aid inspector could give has been widely valued by the employers. It seems that there are many more occupiers who are surprised that the orders do not yet have legal force in their works than those who fail to carry them out in works where they do apply.

Occupiers and workers alike consider the legal requirement a reform long overdue. . . . The Chairman of the Birmingham Bench of Magistrates commenting on the first cases taken into court under one of the orders expressed this view forcibly and the heavy penalties then inflicted are an index of the importance attached to the provision. . . . In an engineering works I was seized upon by a workman engaged in very dirty work who produced from his pocket a newspaper cutting about the order . . . and said "now perhaps I shall get my opportunity at last." He was the "First Aid" man, whose only appliances hitherto had been a few rolls of bandage and whose "surgery" had consisted of a very dirty tool room bench. The firm have now (although not employing 500 persons) equipped a small dressing station wherein all appliances mentioned in the order are kept. The provision of ambulance rooms and first aid appliances is undoubtedly spreading in industries outside the orders. Well-equipped surgeries are now found in clothing works, rubber works, rope and twine works, and it is the exception not to find first aid equipment in gas works, breweries and other places where women are largely employed as labourers. (Miss Escreet.)

Boot and shoe factories, biscuit factories, bleach and dye works, cotton textile and other factories are mentioned by various inspectors as equipped with first-aid outfit.

In Dundee I found all the jute mills provided with first aid outfit-cabinets similar to those required under Home Office Orders. The provision has been made voluntarily in accordance with the advice of the certifying surgeon. One works has first aid classes for the women in winter time, and many of the weavers take the course and sit the examination. The knowledge they gain is often useful to them in their homes, even if they are less likely than the men to have it tested at the works. (Miss Meiklejohn.)

The distribution of the orders, to all the works in the divisions known to fall under them, has lain with the district inspectors — who already had done much preliminary preparation of the ground by issuing copies of the Home Office First Aid Leaflet (Form 923) and by systematic following up of reports from certifying surgeons on cases of sepsis.

> The standard of compliance with the terms of the orders is already, in consequence, much higher than would otherwise have been the case. In the majority of the works under the orders first aid equipment of a sort has been provided for some time. . . . In many works the dressings, etc., were kept in dusty cupboards or drawers containing other articles and dressings were obviously not kept sterilised. . . . The provision of ambulance rooms has received special attention. . . . In a few cases delay has arisen through shortage of labour or materials, but these difficulties are being overcome. In about half a dozen of the largest works (in the S. W. Division) the ambulance rooms are in charge of a resident medical officer and full-time attendants. Either nurses or trained first aid men are at other large works. (Mr. Rogers.)

Similar accounts are given in other divisions. In the S. E. Division Mr. Williams, and in the N. E. Division Mr. Wright, add that in some of the smaller factories arrangements were not satisfactory, and that better progress has yet to be made: in some cases occupiers had taken no steps to comply with the order until reminded by the inspectors.

In the N. W. Division, Mr. Jackson thinks there is a falling off in the cases of septic poisoning, and in the N. E. Division Mr. Wright says that the keeping of records in ambulance rooms has awakened very many to the great magnitude of smaller accidents that occur. Mr. Harston, in the Midlands, refers to the great extension during the war in controlled works of good provision of ambulance and rest rooms and appointment of trained nurses and qualified medical attendants, before the orders. . . .

Some inspectors comment on the small amount of training found among persons in charge of first aid boxes and the absence as yet of any great movement for forming classes for such training. At the same time good instances are given of inauguration of courses in Huddersfield, Sheffield and elsewhere. Mr. Wilson says that the opinion of inspectors in the Northern Division is in favour of trained women attendants for ambulance rooms rather than men.

> They keep the appliances and the rooms neater and cleaner and are very deft and gentle in dressing wounds. Having had some experience of both I rather take the same view, particularly if the attendant has had a year or two of hospital experience. The contrast in general method, in neatness and cleanliness of a modern ambulance room under the care of a woman with some hospital training and one attended by a man, with even considerable first aid experience, is very marked indeed, and all in favour of the former.

Rest Rooms. — Except as an adjunct to ambulance rooms and messrooms, the inspectors do not in 1918 generally refer to development of this new feature in certain directions in factory life. Mr. Harston, however, reports that they are not uncommon with libraries attached. The inspectors have in previous years — both during and before the war — pointed to the value of rest rooms, in enabling young workers, especially, to recover from slighter ailments or passing faintness. I have personally in munition and aeroplane factories observed and been struck by their usefulness for women workers where the nature of the work is continuous and does not allow of sitting at all during the working spells. A highly-skilled woman, in charge of a gang of women engaged in fitting aeroplane wings with certain metal appliances, told me that she and her women had, with the aid of a rest at the end of a spell, developed power to work standing without injury and apparently with benefit to health.

The development of the factory rest room in connection with cloakrooms, as well as with ambulance and messrooms, in national factories, and, under the guidance of the Welfare Department of the Ministry of Munitions, in controlled munition works, is a matter of common knowledge. It is a valuable aid to future administration by the Factory Department that this institution in aid of the well-being and energy of workers should have been so widely advertised and used during the stress of war production.

Supply and Use of Seats. — Relatively little advance is reported in 1918 in this condition of health and efficiency, and on the whole the position has not markedly changed from earlier years. The experimental order for supply of facilities for sitting, for all women and girl workers engaged in shell-making, was much needed and very useful, but as it came into force only on 1st August, 1918, and shell factories closed down rapidly after November 11th, it had but a short course to run. In many factories compliance was secured and seats were in use, in others supplies of seats were coming in when work began to cease. It was, says Miss Vines, greatly appreciated in Scottish factories.

Miss Lindsay says that in the shell factories in the N. W. Division the main objection was made by firms who thought that the order meant that the work should be done seated, and that they withdrew the objection when they realised that seats need only be available for use as opportunity occurred. No doubt this has been a frequent misunderstanding and cause of opposition to legal regulation of the matter, but from reports of welfare superintendents, as well as communications from managing directors themselves, it is clear that there is still some opposition to remove, finally, that is based purely on an idea among managing foremen that proper discipline requires the worker to stand, more or less "at attention," throughout working hours. Manufacturers themselves show more favour to provision of seats sometimes than their foremen.

Miss Martindale comments on the disappointingly slow progress in development of useful kinds of factory seats, suitably shaped and easily adjustable and of suitable materials. This slow process is perhaps rather natural until a sufficiently wide demand for the seats is forthcoming. The issue in due course of the Home Office pamphlet on this question will strongly reinforce and extend the wiser councils that hold even now among many employers. Admirable arrangements have, in fact, been made by those who realise the value of saving energy and preventing needless fatigue and who know that access to occasional rest does not "encourage laziness and lessen output" if properly organised. . . .

Supervision of Workers. — This is the last in the specified list of subjects in the welfare section of the Act of 1916, and as yet no order has been made under that section for supervision of workers as distinct from conditions. In national munition factories, and to a very wide extent in controlled factories, under the guidance of the Welfare Department, Ministry of Munitions, and in pursuance of memoranda of the Health of Munition Workers' Committee this means of initiating and guiding development of welfare held a very prominent position. Time being of the essence of the matter in production of munitions, naturally personal development, at the works, of means of welfare, was bound to be rapidly used while various more concrete conditions were being forged out and tested. This is clearly seen also in the general emergency order for relaxation of hours in munition factories first issued by the Home Office on 31st March, 1915, and revised, September, 1916. The requirement there of personal supervision of women and girls on night

shifts by a competent woman was carried over into other Home Office emergency orders that followed, and was a prominent feature in the order for brickworks, allowing the employment by day of girls under 16 years of age. An extraordinary impetus was given to training and growth in number of candidates for this relatively young branch of social welfare, to which I make further reference below.

Although under the Act of 1916 supervision of workers is not yet required, and its decisive development has been mainly under voluntary guidance and emergency requirements, yet a beginning of expert supervision of conditions affecting workers' health and welfare is provided for in the tinplate factories and other special cases to which welfare orders applied in 1918, and in further draft orders issued in the current year, *e. g.*, to laundries, fruit preserving, and oil and seed cake factories. In all of these, cloakrooms, washing facilities and messrooms "shall be placed under the charge of a responsible person and shall be kept clean." In this provision lies a sure ground-work or starting-point for building up of expert management of material conditions for the welfare of workers at the very time when workers' welfare committees are springing up in many places and can effectively co-operate, and not least by expressing the workers' needs and wishes in these matters.

In the most important divisions as regards production of munitions, the superintending inspectors all report in 1918 on the numerous appointments of men and women supervisors in the larger factories.

> These officers concentrate on working conditions, recreation, sport, rest. . . . In occasional instances they have arranged for lectures by managers and foremen during working hours and the latter part of mealtimes. The interviewing of applicants for employment and the forwarding of a quarterly report to the parents of boys is also undertaken by some of these officers. (Mr. Wright, N. E. Division.)
>
> Last year . . . many new appointments of women and men supervisors were made. . . . Large numbers of women have been appointed during the war to organise and control welfare work in factories and the experience of the benefits following these appointments has shown to employers the desirability of extending the principle to boys and, in a measure, to men. (Mr. Rogers, S. W. Division.)

The tremendous changes effected in industry by war have brought the whole problem of skilled supervision of conditions in factories forward, into a new aspect, with rays of light bearing upon it. When the first meeting of social secretaries and welfare superintendents was convened at Bourneville in 1906, by employers who had for long been among the chief leaders of the idea of skilled supervision, industry was still held fast in its predominantly economic framework. Welfare work in the main had to be justified to the average employer as a humanitarian or philanthropic movement on the one hand, or as a direct matter of efficiency in output — a sound business proposition — on the other. In the great movements, by tens of thousands of workers, to and inside munition factories, followed by the highly specialised campaign for dilution and substitution of women in all industries, supervision emerged in its new light as essentially both leadership and true management. And that is why in various quarters it failed, and was adversely assailed, where it still tried to continue and survive as a merely superimposed factor on unreformed factory life. The workers knew very well where the shoe pinched, and that welfare cannot be either a graft or veneer on poor or bad conditions. They have valued and welcomed supervision wherever it came in as a new art of factory life, and the supervisors when they were equipped with scientific training and with good experience. Dr. Collis, speaking at a public health conference at the Royal Sanitary Institute early in the current year, estimated the total number of women welfare workers of various grades appointed

to care for women and girls as approximately 1,000, and for boys as 400. In these numbers, so rapidly increased from the few hundreds at the beginning of the war, both the great need of such workers can be seen and in some degree the cause of failures among them. And yet, when the total number of factories is considered, the movement may be said to be still in its infancy.

The Home Office pamphlets and *Memorandum on Substitution of Women* indirectly bring out the great significance of the new managerial side of supervision by women in factories. And this is the side on which it is impossible not to be impressed, as Miss Martindale says, with the need of supervision of a kind that will secure "faithful and careful carrying out of all the necessary regulations and ensure general welfare of the workers." . . .

Miss Escreet has, in the Midlands, had wide and varied experience of types of welfare supervision and she shows that there are more ways than one of securing active co-operation from the workers:

> We have come across many opinions with regard to welfare supervisors, but even those occupiers and workers who dislike them most have to admit that they always have the messroom and lavatory kept clean. The supervisors themselves would claim this of course as the most elementary of their duties, but factory managers have had to learn that what is everybody's business is nobody's business, and that messroom and lavatory equipment gets out of order if it is not regularly attended to, just as machines and boilers do. They do not always realise that it is the responsibility for seeing that work (*e. g.*, cleaning) is done, that is the important thing. An instance of the members of a works' committee taking real responsibility was found by Miss Hutchinson at a factory in Wales. The women members of the works' committee were responsible for supervision at night under the General Munitions Order and were paid extra for this work. The supervision was carried on in a thoroughly systematic manner and the arrangement appeared perfectly satisfactory. At one factory where Miss Mellor found the messroom and lavatory unusually well kept the work was carried on by means of a "monitor system," adopted after the rejection of a welfare supervisor. Three girls had been chosen as monitors and were responsible in weekly turns for discipline in shop and messroom for the cleaning of the messroom, etc., and for general matters concerning the women employed. The monitor on duty received extra payment, and the system was said to work excellently and without jealousy. The tendency of the large firms pressed into substitution or dilution by the Ministry of Munitions has been to turn to the educated women to control women workers they were obliged to employ, and I have recently come across an instance of a woman's successful management of a factory engaged in the manufacture of pickles and sauces.

In several of the increasingly numerous books on welfare and scientific management of conditions of health and welfare it is amply recognised that supervision of this side of factory life must be an integral part of the general management, in order to secure both an adequate bedrock on which to build and progressive improvement. "There can be no second man in matters of human import. Either the general manager must be in effect the employment manager, or the large employment scheme will not work. Put the kind of employment manager required to administer this (welfare) scheme . . . under a general manager without a social point of view and one of two things must happen. Either the programme waits while the employment expert is saving the soul of the general manager and really fitting his superior to do the superior job, or the expert must quit, a failure" (7). Signs are not wanting, however, in our factories that the workers themselves are co-operating with both managers and experts in new ways that may happily solve the problems on democratic lines.

Organized Initiative of Employers and Workers

A great movement forward in general industrial welfare and health may be expected when both joint standing industrial

councils (national and district) and works' committees thoroughly representative of workers and employers, with due provision for representation of women workers come into full activity, aided on the technical side of factory welfare by an expert factory inspectorate and access to a well-developed industrial museum. It is impossible in this report to do more than indicate, by such instances as those given in the foregoing paragraphs on observance of orders, the extensive work that is already in preparation, with active co-operation and guidance from the factory inspectors.

Some examples may, however, be referred to of more direct voluntary initiative of organised employers and workers. In October, 1918, Mr. A. C. Yates, ex-President of the Leicester Chamber of Commerce, himself connected with a firm of worsted spinners, issued a *Report on Industrial Welfare Work* in that town based on a formal enquiry he had sent out a few months earlier with the consent of the Chamber of Commerce to 310 firms in the town, covering a wide range of subjects. In the report he defined welfare work as including all endeavours made by employers, with the assistance of their employees, to improve the conditions of workers beyond the actual requirements of the Factory Acts, including wages and hours of employment, housing, profit-sharing, rest rooms, messrooms and canteens, first aid appliances, additional lavatories, cloakrooms, baths and gymnasia, indoor and outdoor games, evening entertainments and lectures, welfare secretaries. Some of these and a few other points Mr. Yates included in his *questionnaire* to firms, the result of which is summarised as follows by Mr. Harston, Deputy Superintending Inspector for the Midland Division:

Only 110 forms were returned. This disappointing result, Mr. Yates thought, was probably due to a natural objection felt by many to filling up forms with so many replies in the negative, and also that they were all getting tired of filling up forms. He had purposely left wages and hours and the provision of houses out of consideration. The health of the workers was so bound up with industrial welfare that the subjects could not be definitely separated except in certain trades where special sanitary precautions had been taken. The true welfare of a person was marred not only by physical weakness but also by discontent, monotony, and lack of interest in life.

The replies he received showed that 39 firms had cloakrooms and lavatories in addition to the Factory Act requirements, 42 had messrooms, and 5 had accommodation for cooking food, while 6 had fully equipped canteens, 14 had rest rooms, 70 provided first aid appliances, 7 supplied a medical or dental service, 46 had benefit or sick clubs, 4 had pension schemes, supplementing the government scheme, 22 had adopted compulsory uniforms in certain departments, 1 had a gymnasium. A fourth of the replies stated that some entertainments of the workpeople were being organised, 11 had holiday schemes. Half of the firms were offering inducements to attend continuation and technical schools. One had educational lectures. Nine had welfare supervision. One-fourth of the firms had some scheme for the visitation of absentees or sick employees, and a similar number had representative works' committees; 42 firms encouraged, by rewards, suggestions from workpeople with regard to economics, 6 had co-partnership or profit-sharing schemes, and 21 had spare land cultivated by employees.

The question "Have you any other kind of welfare work ?" produced very few replies, but two were specially interesting. One firm had an institute providing billiards, skittles, cards, refreshments, etc., and the other had purchased a farm of 150 acres with a farmhouse, and a large house suitable for a convalescent home.

The *questionnaire* had been prepared in the hope that many would feel prompted to make new endeavours to add to the welfare of those who were in their employment.

In March, 1918, a conference, convened by the British Association for Industrial Reconstruction, between organisers of trade unions, Bristol employers and others concerned with the industrial employment of women, was held at Shipham, Somerset. Their strong support was given to the policy of the Whitley Reports of constituting a new control in industry by

establishing in each industry a system of self-government through joint standing industrial councils equally representative of organised employers and operatives engaged in it, and the great potential value of works' committees for the satisfactory conduct of industry in detail was specially stressed. The belief was further strongly maintained that there is a "great field of usefulness open to welfare work, conducted by suitable and properly trained persons," with a view to humanising industrial life. The function, they said, of a welfare supervisor, is "to see that proper attention is paid to the human as contrasted with the productive aspects of factory life and work," and the description could hardly be bettered for practical guidance.

The conference at Shipham, including trade union leaders and employers, gave decisive support to the movement for a new humanising of factory conditions by methodical administrative means. After animated debate not free from warm arguments, even "supervision" of welfare, of the right kind, was admitted as indispensable. Equally decided was the memorandum on *Welfare Supervision* (April, 1918), published by the Woolwich District Trade and Labour Council, assuming as it did that the supervision was primarily for the workers' welfare and not really aimed at increasing their output, and that no supervisor should be appointed without preliminary training and experience to include knowledge of trade union aims and methods. This memorandum indeed called for a co-ordinated extension of welfare schemes among small factories with development of efficient co-operation in matters of health, housing, transit and recreation with the municipal authorities. . . .

The new educational experiments of employers, found in an increasing number of factories, seem likely to both strengthen and enlighten the development of self-government in industry. These experiments vary in a wide and instructive degree. Some are directly associated with the organisation of welfare in the sense of the Act of 1916, others are an avowed effort to act as forerunners of the requirements of the Education Act of 1918 by carrying on the education of girls and boys from the school leaving age, when they enter the factory, either to 16 or (in some cases) to 18 years of age, both in works' schools and by payment of fees for continuation classes outside the factory. Even where, as in other cases, they frankly tend rather especially to fit the workers to become good and efficient factory workers than to supply them with more general education, instances are not lacking of original and promising experiment. It has been found where serious continuation teaching has been given for two years to girls from 14 years onwards in well organised works' schools, under direction of a county council organiser, that education of forewomen is also necessary in support of control and authority in the work of the factory. To these forewomen teaching is now given in industrial history as well as English, arithmetic, physical exercises and home nursing, with the aim of enabling them to keep hold of the proper influence with the young workers under their charge, who are advancing rapidly in physique, *morale* and intelligence under liberal teaching provided for them in the works' school. . . .

BIBLIOGRAPHY

1. For development of this idea see Ioteyko, J.: The Science of Labour and Its Organization. London, George Routledge & Sons, Ltd., 1919; New York, E. P. Dutton & Company, 1919.
2. Watkins, G. P.: Welfare as an Economic Quantity. Boston and New York, Houghton Mifflin Company, 1915.
3. Smart, W.: Economic Annals of the Nineteenth Century, 1910, p. vii.
4. Messrooms and Canteens at Small Factories and Workshops. London, H. M. Stationery Office, 1918.
5. Protective Clothing for Women and Girl Workers. London, H. M. Stationery Office, 1917.
6. Obtainable from H. M. Stationery Office, Underwood Street, Shepherdess Walk, City Road, London, N., or from H. M. Chief Inspector of Factories, Home Office, London, S. W. 1, or from the Employment Department, Ministry of Labour, Queen Anne's Chambers, London, S. W. 1.
7. Fisher, B.: Industrial Loyalty. London, George Routledge & Sons, Ltd., 1918, p. 15.

BOOK REVIEWS

Injuries to the Head and Neck. By H. Lawson Whale, M.D. Camb., F.R.C.S. Eng., Capt. R.A.M.C. (T.F.), formerly Capt. I.M.S. (retired); The Queen's Hospital, Sidcup; No. 83 General Hospital; and Surgical Specialist to No. 53 General Hospital, B.E.F.; Surgeon for the Ear, Throat, and Nose to the London Temperance Hospital, and to the Hampstead General Hospital. With preface by Col. Frederick F. Burghard, C.B., M.D., M.S., F.R.C.S. Cloth. Pp. 322 with illustrations and index. New York: Paul B. Hoeber, 1919.

This is distinctly a book for reference in industrial surgery. Entirely a treatise on war surgery of the head and neck, it deals with the difficult problems arising from shell and gun shot wounds of these parts. Naturally, similar problems arise seldom in industrial work and only occur when a piece of flying steel strikes the head or neck — an uncommon accident.

The chapters on rhinoplasty are of interest and of considerable value to the industrial surgeon inasmuch as injury to the nose of an extensive character is occasionally met with, and the technique here outlined is very valuable as a guide. There is an excellent section on after-treatment and dressings of these difficult cases.

In the chapters on the treatment of jaw injuries, the treatment of jaw fragments is particularly valuable, while the difficult problem of anesthesia is well discussed.

The general plan of the author is to discuss the injuries and their treatment generally, and then to give specific instances of cases under his personal observation. For surgeons desiring a well written, clearly illustrated book of convenient size devoted to severe injuries of the head and neck, Doctor Whale's book will prove a valuable work. — *W. Irving Clark, Jr.*

Textbook of Meat Hygiene. With Special Consideration of Antemortem and Postmortem Inspection of Food-Producing Animals. By Richard Edelmann, Ph.D., Medical Counsellor; Royal State Veterinarian of Saxony; Professor at the Royal Veterinary High School in Dresden. Fourth revised edition by John R. Mohler, A.M., V.M.D., Chief, U. S. Bureau of Animal Industry, and Adolph Eichhorn, D.V.S., Director, Veterinary Department, Lederle Antitoxin Laboratories; Formerly Chief, Pathological Division, U. S. Bureau of Animal Industry. Cloth. Pp. 472 with index and illustrations. Philadelphia: Lea & Febiger, 1919.

An exceedingly important item in the dietary of the people of this country is meat, and its sanitary production and handling should be thoroughly safeguarded in every possible way. It was stated by Dr. Mohler last year that one-third of the meat consumed in this country did not undergo federal inspection. Yet the need for complete and efficient meat inspection is great when we consider the enormous quantities of meats that have to be condemned on account of disease or unsoundness.

The scope of meat hygiene is a broad one and is founded on strict scientific principles which this newly revised edition of Edelmann's text-book endeavors to present in the light of American conditions and experience. The various phases in the production, preparation, and conservation of meat are taken up from a practical standpoint, and the regulations of the United States Department of Agriculture governing meat inspection are given in detail, together with the organization and methods of procedure of the inspection force. Following this exposition of the administrative side of meat hygiene there are discussed the abnormal conditions and diseases of food-producing animals, the postmortem changes of meat and the examination of prepared and preserved meats. Most of the essential information on meat poisonings is presented, as well as a history of meat hygiene, followed by chapters on abattoirs and stockyards and the preparation and control of meat-food products. A brief summary of some of the more important and useful chemical analyses in meat inspection is appended. — *Barnett Cohen.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Negro Migration During the War. By Emmett J. Scott, Secretary-Treasurer, Howard University, Washington, D. C. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 16. Edited by David Kinley, Professor of Political Economy, University of Illinois, and Member of Committee of Research of the Endowment. Paper. Pp. 189 with bibliography and index. New York: Oxford University Press, 1920.

A Manual of Physical Diagnosis. By Austin Flint, M.D., LL.D., Late Professor of the Principles and Practice of Medicine and of Clinical Medicine in Bellevue Hospital Medical College, etc. Eighth Edition revised by Henry C. Thacher, M.S., M.D., Assistant Professor of Clinical Medicine in the College of Physicians and Surgeons of Columbia University, Assistant Attending Physician, Roosevelt and Lincoln Hospitals, New York. Cloth. Pp. 362 with illustrations and index. Philadelphia: Lea & Febiger, 1920.

Sanity in Sex. By William J. Fielding. Cloth. Pp. 333 with index and bibliography. New York: Dodd, Mead and Company, 1920.

Early Effects of the War upon the Finance, Commerce and Industry of Peru. By L. S. Rowe, Ph.D., LL.D., Professor of Political Science, University of Pennsylvania. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 17. Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Paper. Pp. 60. New York: Oxford University Press, 1920.

INSTITUTE OF INDUSTRIAL NURSING

An Institute of Industrial Nursing under the auspices of the New Haven Visiting Nurse Association will be held September 20 to 30, inclusive, at 35 Elm Street, New Haven, Conn.

An intensive and interesting program has been prepared and the following experts in Public Health will give lectures:

C.-E. A. Winslow — Industrial Hygiene.
Florence Swift Wright — Industrial Nursing.
C. C. Burlingame — Hospital Management and Record Keeping.
George Blumer — Industrial Diseases.
R. M. Thompson — Industrial Relations.
Mary P. Wheeler — Social Problems.
H. C. Link — Industrial Psychology.
Maria Nelson — Nutrition and Budgets.

Only graduate registered nurses interested in industrial work are eligible — preferably nurses with public health experience.

The fee is $5.00, payable at time of registration, which must be not later than September 12.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II SEPTEMBER, 1920 NUMBER 5

EFFICIENCY OF THE PALMER APPARATUS FOR DETERMINING DUST IN AIR *

S. H. KATZ

Assistant Physical Chemist, Bureau of Mines

E. S. LONGFELLOW

Assistant Chemist, Bureau of Mines

AND

A. C. FIELDNER

Supervising Chemist, Bureau of Mines

TABLE OF CONTENTS

INTRODUCTION

IN connection with the improvement of conditions relating to the health of workers in the mining and metallurgical industries, the Bureau of Mines has co-operated with the U. S. Public Health Service in determining the amount of injurious dust suspended in the atmosphere. The three methods for dust determination most commonly used are: (a) washing out the dust from a measured flow of air with a water spray, as in the Palmer apparatus (1); (b) filtering out the dust from a measured flow of air with a water-soluble granular medium, as in the sugar tube method (2); (c) forcing a definite volume of air at high velocity through a small orifice against a coated glass plate to which the particles adhere so that they may be counted subsequently with the aid of a miscroscope. The Hill dust counter (3) and the Konimeter (4) depend on this principle. None of these methods is entirely satisfactory and all of them fail to include all the finer particles which are, when inhaled, the most injurious.

A critical study of the efficiency of these methods with respect to very fine particles seemed very important, especially as new means for making this study are now available in the methods developed for testing

* Published by permission of the Director of the United States Bureau of Mines. Received for publication April 9, 1920.

the effectiveness of gas masks and other protective devices against poisonous and irritating smokes. This paper gives the results of such a study of the Palmer apparatus and is the first of a series which will ultimately cover the various method for determining dust in air.

Fig. 1. — The Palmer dust sampler.

Description of the Palmer Apparatus

Figure 1 shows the Palmer apparatus, which is completely built into a portable case. The washer consists of the large pear-shaped glass bulb with a U about one inch in diameter at the bottom. One side of the U is open to the air. Forty cubic centimeters of pure water are charged into it for a test; this amount causes the level in each arm of the U to rise one-quarter inch above the point of separation. Air is drawn through the water by means of a small blower, operated by a direct-connected motor using power from lighting circuits. The rate of flow of the air is measured by a pitot tube and an inclined gauge; the scale is graduated in cubic feet per minute, ranging up to 6. Rate of the flow is controlled by means of a sliding disk which closes the outlet from the blower.

To test the Palmer dust sampler, the pear-shaped glass bulb, which is the essen-

tial part, was removed from the case and connected into an apparatus for measuring its efficiency. Two methods of testing were employed. The first was based on optical comparison of the light (Tyndall effect) from suspended matter in the streams of incoming and outgoing air; tobacco smoke and air-suspended silica dust were used as testing mediums. The second method was based on weighing the matter, which passed the washer, by catching it in the small light tube of a laboratory Cottrell precipitator and determining its gain in weight.

The tests made in this manner showed that the Palmer apparatus removed not more than 13 per cent. of tobacco smoke from air, measured by the method based on light reflection. By the same method of measurement, silica dust, air floated and then filtered through cotton wool so that it was very finely divided, was removed to the extent of 30 per cent. when the suspension passed at the rate of 4 cubic feet per minute, and 20 per cent., at the rate of 3 cubic feet per minute. On a weight basis, as determined with the Cottrell precipitator, 45 per cent. of the silica dust was removed by the Palmer apparatus at flow of 4 cubic feet per minute. On a numerical basis the efficiency must be considerably lower than the 30 per cent. efficiency found by the optical tests.

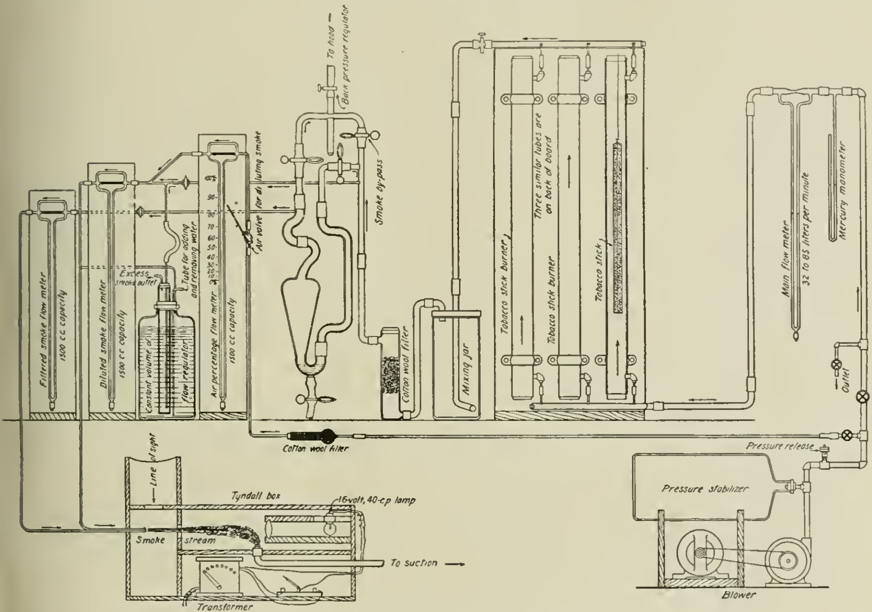

FIG. 2. — Apparatus for testing the washer against tobacco smoke, with optical measurements of washing efficiency.

Tests with Tobacco Smoke

Description of the Apparatus for Optical Determinations of Efficiency

Figure 2 shows a diagram of the apparatus used for testing by the means of optical comparison, using tobacco smoke as the

testing medium. Wells and Gerke (5) showed that particles of tobacco smoke measured 0.273 microns on the average, with an average deviation of 1.8 per cent. The tobacco smoke used by Wells and Gerke (5) for these measurements was produced in the same way as the smoke used in the work described in this paper. Since tobacco smoke particles are of so small and uniform a size and have very little tendency to clog a filter, they make an excellent medium with which to test.

At the right of Figure 2 is a small motor-driven rotary blower which furnished air under pressure. The pressure was maintained at 100 mm. Hg by regulating a screw clamp on the outlet end of the apparatus. This pressure, which was sufficient to force air through the entire apparatus, against the resistance of the washer and other parts, was measured by a mercury manometer near the pump. After the manometer, in the direction of flow, is a flow meter which measured the rate of flow of the air. Regulation of the rate was obtained by means of the valves on the pipes near the pump. After leaving this flow meter, a portion of the air passed through the 2-inch iron pipes, arranged six in parallel, which constituted the tobacco burners.

The tobacco as used, had been molded into sticks by the following formula: Sun-dried tobacco leaf was ground and screened to the sizes needed. The sized material was mixed with potassium nitrate and rosin for binder, as well as smoke production, in these proportions:

Tobacco, 20–40 mesh	500 gm.
Tobacco, 40–60 mesh	300 gm.
Tobacco, 60–70 mesh	200 gm.
Rosin, through 100 mesh	475 gm.
Potassium nitrate through 60 mesh	100 gm.

This mixture was pressed into a sheet-iron mold of 1-inch-square cross section and 15 inches length, open on one side. The mold was lined with paper to prevent sticking. Candle wick was imbedded in the center of the tobacco stick to add strength. The mold and mixture were baked on a hot plate, under the cover of a half round of sheet iron, 3 inches in diameter. All four sides of the stick were baked in turn to a brown color, the mold being covered with a strip of sheet metal before inverting to bake the exposed side of the stick. Smoke from sticks prepared in this way showed no carbon and the ash was also free from carbon.

The air with smoke from the tobacco burners passed through a large jar where it was mixed with air which had been by-passed around the burning tobacco, and then through a small jar containing a wad of cotton wool for filtering out large particles. Then it passed through the pear-shaped washer of the Palmer apparatus. From the Palmer washer, the air, with included smoke, escaped into a hood. The tubes were also arranged so as to by-pass the smoke around the Palmer washer and to the hood directly, when desired.

The remaining apparatus was used for measuring the proportion of smoke which escaped the Palmer washer. On the outgoing side of the washer a small glass tube, connected to a stopcock and flow meter, allowed 1500 c.c. per minute of the filtered air and smoke to pass through a glass nozzle, one-eighth inch in diameter, into a light beam in a Tyndall box. Smoke from the incoming side of the washer was drawn through a similar small tube, stopcock and flow meter, and discharged through a glass nozzle in the Tyndall box, placed parallel to and one-quarter of an inch away from the other nozzle. The two systems for conducting the incoming and outgoing smoke to the Tyndall box were made identical in size and length of tubing, constrictions and bends, so as to have equal effects on deposition of smoke particles on the walls. In order to make a comparison of the den-

sity of the two smoke streams, the incoming, as regards the washer, was diluted with pure air from the pump. This air passed through a controlling stopcock, with long lever arm for fine adjustments, and a flow meter calibrated in percentages. It was then mixed with the incoming smoke before the smoke came to the 1500-c.c. flow meter. The latter flow meter was equipped with the device of Oberfell and Mase (6) which automatically maintained a constant flow of 1500 c.c. of gas. When no air was added 1500 c.c. of the undiluted smoke passed through the flow meter; when 1500 c.c. of air was admitted to the line, only air passed through the flow meter and the smoke passed out of the system and escaped into the room through the regulator. The smoke left the line from a point behind that at which the pure air entered so no admixture of smoke and air occurred before the excess smoke escaped. When any amount of the pure air less than 1500 c.c. was admitted, it passed through the flow meter, together with the amount of smoke required to make 1500 c.c., and the residual smoke automatically escaped. On the flow meter which measured the pure air, 1500 c.c. per minute indicated 100 per cent. Then if the washer was 50 per cent. efficient, or allowed half of the incoming smoke to pass through it, a mixture of half smoke and half, or 50 per cent., of pure air, was required in the Tyndall box to match the stream of smoke from the outgoing side of the washer. After matching the smoke streams by this arrangement, the percentage efficiencies of the washer were read directly from the water column of the percentage-calibrated flow meter.

The wooden Tyndall box was painted dead black inside. The beam of parallel light, opposite in direction to the streams of smoke, was provided by a lens and a 40-candle power, nitrogen-filled automobile lamp. Voltage was regulated by a small transformer using 110 volt power. Suction on the box removed excess smoke. The line of sight passed through a small opening in the box, which allowed observation of about 3 inches length of the smoke streams, just after they had passed from the nozzles.

Before measurements were made with the apparatus, it was tested blank; that is,

TABLE 1.—RESULTS OF THE OPTICAL MEASUREMENTS OF EFFICIENCY OF THE PALMER DUST SAMPLER TESTED AGAINST TOBACCO SMOKE

Rate of flow of smoke, 4 cubic feet per minute; Water in Palmer bulb, 40 c.c.

	Order of Observation	Observations Perceptibly in Excess of True Efficiency	Observations Perceptibly Below True Efficiency	Remarks
Observations by No. 1, per cent.	1	13		Observations, even at 0 efficiency, were hardly perceptibly lower than the actual
	2		0	
	3	13		
	4		0	
	5	12		
	6		0	
Observations by No. 2, per cent.	7	12		
	8		0	
	9	10		
	10		0	
	11	18		
	12		0	
Aver. of excess fig.		13		

with an unobstructed tube in the place of the washer. The smoke streams in the Tyndall box were required to match under this arrangement. In order to secure this result the apparatus required frequent cleaning.

Procedure in Making Measurements

Experience has shown that a thin smoke serves better for making optical comparisons when efficiences are low — as in the case of the washer — so only one tobacco stick was burned at a time. When filtering efficiencies are high, denser smokes are better and six tobacco sticks may be burned

when measurements of very high efficiencies are to be made. The method assumes that the actual efficiency of the apparatus being tested is independent of the concentration of the smoke. Experience in both the Bureau of Mines and Chemical Warfare Service indicates this to be true.

The accuracy of determinations decreased with decrease in efficiency of the apparatus being tested. With efficiencies of 98 per cent. measurements could be checked to less than 1 per cent., but when efficiencies ranged at 25 per cent. or lower, errors of individual determinations might be 15 per cent. Because of the difficulty of accurate readings with low efficiencies, a number of observations were always made and, in general, this procedure was followed: First a reading was secured which was known to be greater than the actual efficiency by an amount just perceptible in the Tyndall stream; then a reading, lower in efficiency than the actual, was secured in the same way. A series of such alternate observations was usually made by each of two observers. The washer gave best results when air was passed through it at a rate of 4 cubic feet per minute, so this rate was used in the tests with tobacco smoke. At 5 cubic feet per minute some water was carried out of the tube mechanically, while at 3 cubic feet per minute there was less agitation of the water, less spray was produced in the tube and the washing effect was apparently poorer.

Results of the Tests

Table 1 gives the results of the tests. From these figures it is concluded that the Palmer dust sampler has an efficiency not greater than 13 per cent. in removing particles of tobacco smoke from air.

Tobacco smoke consists of liquid particles. Most dusts studied for hygienic purposes consist of solid particles. For these reasons the following tests were made with solid, silica dust.

Tests With Silica Dust

Description of Apparatus for Optical Determinations of Efficiency

In order to determine the efficiency of the Palmer dust sampler in removing solid suspensions from air, tests were made similar to those with the tobacco smoke but with air-floated silica dust as the test medium. The apparatus was the same as for tobacco smoke, except for the tobacco burner. The latter was replaced by an apparatus for creating a cloud or suspension of the dust in the air. The dust cloud pro-

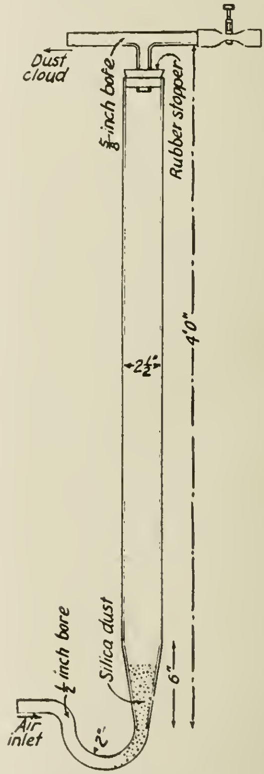

Fig. 3. — Apparatus for producing a suspension of silica dust in air.

ducer, shown in Figure 3, consisted of a wide glass tube, $2\frac{1}{2}$ inches in diameter, tapered at the bottom over a length of 6 inches, to $\frac{1}{2}$ inch diameter. The narrow tube was bent into a U to retain the dust.

TABLE 2. — RESULTS OF OPTICAL MEASUREMENTS OF EFFICIENCY OF THE PALMER DUST SAMPLER TESTED AGAINST SILICA DUST

Test number	1	2
Rate of flow of air — cu. ft.	4	3
Water in Palmer apparatus — c.c.	40	40
Readings of efficiency by No. 1, per cent.	44	39
	20	18
	46	30
	20	12
	45	40
	20	10
Maximum	46	40
Average	32	25
Minimum	20	10
Readings of efficiency by No. 2, per cent.	35	31
	23	10
	37	31
	14	5
	38	20
	18	0
Maximum	38	31
Average	28	16
Minimum	14	0
General average per cent.	30	20

At the top of the tube was a rubber stopper with one hole, through which passed a glass T. One arm of the T connected with the testing apparatus, the other was provided with a rubber tube and clamp, through which dust could be allowed to escape. About half a pound of silica dust was heated to 200 to 300° C. before being put into the tubes, and the air used was dried with calcium chloride. A small amount of moisture prevented formation of good suspensions.

The air carrying the silica dust was filtered through the wad of cotton wool before passing to the washer, so that only the smaller particles took part in the experiments.

With silica dust, precipitation occurred throughout the entire apparatus, gradually, but at a rate much more rapid than that of tobacco smoke. Cleaning was required more often and greater care was used to maintain Tyndall beams of equal intensities in frequent blank tests.

Results of the Optical Determinations

The results of the tests are given in Table 2. They show that the average efficiency of the washer for very finely divided silica dust in air, based on optical measurements is only about 30 per cent. This is at least two and one-half times the efficiency shown for tobacco smoke under the same conditions, which indicates a selective action upon particles of different kinds. Such differences in action may be due to differences in surface tensions resulting on contact of the different substances with water, differences in the electrical conditions of the particles, or differences in size of the particles. The latter seems most probable. Tobacco smoke particles are probably the smaller, and as will be shown later, smaller particles pass through the washer most readily.

At the rate of 3 cubic feet per minute the efficiency against silica dust dropped to only 20 per cent. Altogether, these figures show that the apparatus has an efficiency, under the conditions used, which is quite low.

Description of the Apparatus and Methods for Determining Efficiency by Electrical Precipitation

The optical method of testing gave efficiency measurements based on the combined surfaces — or, more exactly, the light reflected from the surfaces — of the particles leaving the dust sampler, as compared with the surfaces of the incoming particles. Dustiness is commonly reported

in terms of mass and numbers of particles, so the following experiments were designed to give information on a weight basis. Figure 4 shows the apparatus used. The precipitator was a duplicate of that used by Tolman, Ryerson, Brooks and Smyth (7). Current from the laboratory service line (110 volt, 60 cycle, single phase) was passed through a transformer of 500-watt capacity

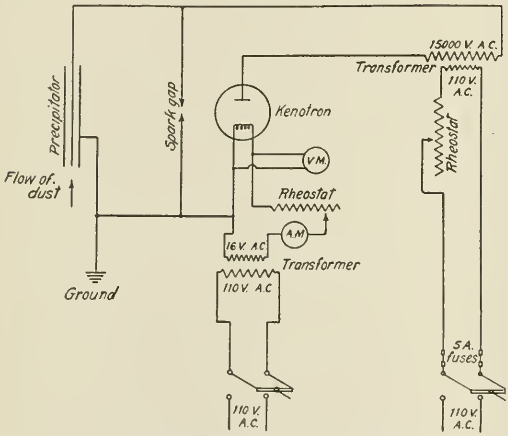

Fig. 4. — Diagram of apparatus used for testing efficiencies of the washer by means of a small Cottrell precipitator.

which stepped it up to a maximum of 15,000 volts. The actual voltage used, probably about 10,000, was controlled by means of a rheostat in the primary circuit. This high-tension current was rectified by a kenotron, which acted as a valve, thus delivering a half of the alternating cycle to the precipitator. The glower coil of the kenotron was heated by a separate transformer, which delivered current at 16 volts. A rheostat in series with the glower adjusted its temperature. The anode side of the high potential circuit was grounded. Voltage across the precipitator was adjusted by stepping up to the sparking point, then reducing slightly to a brush discharge.

The Cottrell precipitator, detailed in Figure 5, was too small to care for the whole of the 4 cubic feet of air per minute which passed through the Palmer tube, so only a portion of it, 32 liters or 1.13 cubic feet per minute, was used in the precipitator. Tests of this arrangement by means of the optical apparatus showed that silica dust was completely precipitated at the start, but as the anode became covered by the silica deposit an increasing amount of dust escaped. Optical measurement gave about 70 per cent. efficiency after one minute for the combined washer and electrical precipitator. The average efficiency of the two during the entire minute was thus about 85 per cent. While it is possible to obtain more complete precipitation with the Cottrell precipitator by reducing the rate of gas flow, other experimental errors are multiplied by the computations required. The arrangement described was therefore considered satisfactory for the purpose in view.

Aluminum foil tubes, which served as anodes of the precipitator, weighed about 0.5 gm. each. Before weighings the tubes were dried in an oven at 100°C. and cooled in a desiccator containing fused calcium chloride. Weighings were made on an assay balance, sensitive to 0.01 mg. Forty cubic centimeters of distilled water were used in the washer for each test. After the 4 cubic feet of air with suspended dust had been passed through the apparatus, the water with the dust caught was carefully rinsed into a beaker and then filtered through a 9-cm. analytical filter paper of close texture (C.S. and S., No. 589, blue ribbon), designed for retaining the finest precipitates. The silica particles were so fine, however, that the filtrate showed considerable turbidity which persisted even after passing through several separate papers or double

papers. Examination under the microscope by Dr. Reinhardt Thiessen of the Bureau of Mines, showed that most of the particles in the filtrate were of the order of 0.25 microns in diameter or smaller, and

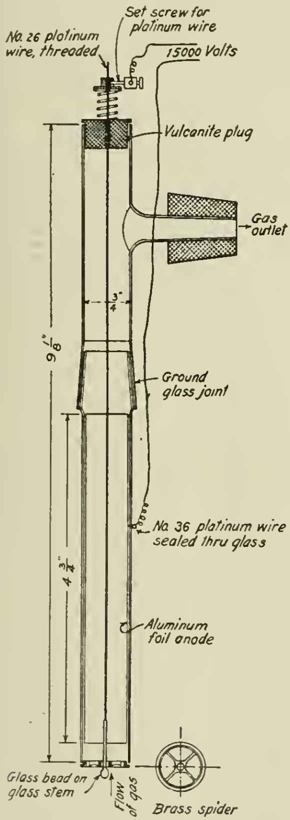

Fig. 5. — Details of the Cottrell precipitator tube.

the largest were 2 microns in diameter. To obtain an estimate of the weight of dust in the filtrate, turbidity standards in water were made with weighed quantities of the finest air-floated dust; the range covered 10 to 1000 mg. of dust per liter of water. Comparison of the filtrates and standards in similar containers and measurement of the volumes of filtrates gave means for calculating the weight of dust in the filtrates. The filter papers with the dust caught by them were ignited and the dust residue weighed. This weight added to that determined by turbidity gave the weight of dust caught by the washer. The sum of the

TABLE 3. — RESULTS OF MEASUREMENTS OF EFFICIENCY OF THE PALMER DUST SAMPLER ON A WEIGHT BASIS, DETERMINED WITH SILICA DUST CLOUDS AND A COTTRELL PRECIPITATOR

Time of sampling, seconds	60	60	60
Data from Palmer washer:			
Water used, c.c.	40	40	40
Air passed, cu. ft.	4	4	4
Weight of dust recovered, mg.	35	32	22
Weight of dust in filtrate by turbidity, mg.	4	3	3
Total dust caught by Palmer tube, mg.	39	35	25
Data from Cottrell precipitator:			
Air passed, cu. ft.	1.13	1.13	1.13
Weight of dust caught, mg.	10.1	13.8	10.7
Final efficiency measured optically of the combined Palmer and Cottrell apparatus, per cent.	70	70	67
Total dust which passed through the Palmer tube, mg.	35.7	48.8	37.9
Total dust carried by the air sampled, mg.	74.7	83.8	62.9
Efficiency of Palmer dust sampler on a weight basis, per cent.	52	42	40

weights of dust caught by the washer and Cottrell precipitator is actually somewhat low because even the two collectors had a combined efficiency less than 100 per cent. by optical determination. However, the result obtained gives a fairly close approximation.

Results on a Weight Basis

Table 3 gives the results of the efficiency determinations on a weight basis. In the last column are the limiting maximum

efficiencies, 52, 42, and 40 per cent., found by three determinations. The average is 45. Actual efficiencies are believed to be not much less than the figures determined because the dust which escaped was probably so impalpably fine that its weight was of little consequence, although on the basis of surface or numbers the loss was probably large. The efficiency determined by weight averages 50 per cent. greater than that determined optically.

The results of the weight determinations show even a lesser efficiency than that found by Bill (8), who reports 63.0 per cent. efficiency on a weight basis for the Palmer dust sampler as compared with an electrical precipitator, as an average of 71 determinations made on different factory dusts. The efficiencies determined by Bill and the authors may be considered of the same order, and the differences are probably due to differences in the character and size of the particles handled.

Discussion of the Results

The optical methods of testing gave efficiencies based on the surfaces of the incoming and outgoing particles. Dustiness is commonly reported in terms of mass and numbers of particles, so it will be well to inquire into these relations as they concern the efficiencies determined by the two methods employed.

The aggregate surface of a given mass of silica particles, uniform in shape and composition, increases as the first power of the decrease in diameter of the particles. The numbers of particles in a given mass of dust, uniform in shape and composition, vary inversely as the third power of the diameter of the particles. Thus both surface and numbers of particles of a given aggregate mass increase with the fineness of division, but the number of particles increases at a rate very much greater than the surface.

On the basis of the above statements it may be that a small number of large dust particles has a greater mass but smaller surface than a large number of small particles. If the Palmer apparatus is more effective in removing large than small particles from the air, it is thus possible, with dust of mixed sizes, for it to show lower efficiencies optically than by weighing. Since the optical efficiencies were lower, it is concluded that the apparatus is more efficient for determining dust of larger sized particles.

Since the numbers of dust particles increase at a very much faster rate with fineness of division than the surface, and since lower optical efficiency was found, it is concluded that the efficiency of the washer on a numerical basis must be even lower than that determined optically.

Tobacco smoke, according to Wells and Gerke (5), consists of particles of quite uniform diameter, hence they may be taken as uniform in surface and weight. The efficiency of the washer — less than 13 per cent. — found by the optical method, is then a measure of the weight and number efficiency.

Summary and Conclusions

The efficiency of the Palmer dust sampler was determined by the use of tobacco smoke and of silica dust. Two methods of testing were used. The first determined efficiency on the basis of the surface of the particles entering the apparatus as compared with the surface leaving, by the use of the Tyndall effect. The second method, based on the weight of dust, used a small laboratory Cottrell precipitator in series with the Palmer washer. The tests showed:

1. That the Palmer dust sampler retained about 45 per cent. by weight of air-floated silica dust when air was passed through it at the rate of 4 cubic feet per minute.

2. The surface efficiency with silica dust, measured by the Tyndall effect, was 30 per

cent. when the air passed at a rate of 4 cubic feet per minute, and 20 per cent. at 3 cubic feet per minute; at 5 cubic feet per minute, water was carried mechanically from the washer.

3. The efficiency based on numbers of the silica dust particles is probably lower than the surface efficiency.

4. The Palmer apparatus was less than 13 per cent. efficient in retaining tobacco smoke, as measured by the Tyndall effect. Assuming tobacco smoke particles to be of uniform size, the optical efficiency of less than 13 per cent. should also apply to weight and number efficiency.

BIBLIOGRAPHY

1. Palmer, G. T.: A New Sampling Apparatus for the Determination of Aërial Dust. Am. Jour. Pub. Health, 1916, **6**, 54.
2. General Report of the Miners' Phthisis Prevention Committee, Union of South Africa, March 15, 1916, 199 pp.
   Final Report of the Miners' Phthisis Prevention Committee, Union of South Africa, January 10, 1919, 110 pp.
3. Hill, E. Vernon: Quantitative Determination of Air Dust. Heating and Ventilating Magazine, 1917, **14**, 23.
4. Final Report of the Miners' Phthisis Prevention Committee, Union of South Africa, January 10, 1919, 110 pp.
5. Wells, P. V., and Gerke, R. H.: An Oscillation Method for Measuring the Size of Ultramicroscopic Particles. Jour. Am. Chem. Soc., 1919, **41**, 312.
6. Oberfell, G. A., and Mase, R. P.: An Automatic Compensating Flow Meter. Jour. Ind. Eng. Chem., 1919, **11**, 294.
7. Tolman, R. C., Ryerson, L. H., Brooks, A. F., and Smyth, H. D.: An Electrical Precipitator for Analyzing Smokes. Jour. Am. Chem. Soc., 1919, **41**.
8. Bill, J. Penteado: The Electrical Method of Dust Collection as Applied to the Sanitary Analysis of Air. Jour. Ind. Hyg., 1919, **1**, 323.

THE COST OF VENEREAL DISEASE TO INDUSTRY*

RAY H. EVERETT

Associate Director, Department of Public Information, American Social Hygiene Association

BUSINESS executives are ever on the alert to learn new methods for eliminating industrial wastage, from whatever cause it may result. They know that the strands of personal service strengthen the fabric of *efficiency*; hence their desire to secure better housing facilities for employees, their endorsement of "safety first" and public health movements, their co-operation in recreational efforts and their increasing interest in all activities covered by the general term, social hygiene. This attitude serves a threefold purpose. It conserves the health of the employee, promotes harmony between him and the employer, and increases the financial returns to both — the one through the medium of wages or profit sharing, the other by increased dividends. These reasons explain the rapidly increasing interest taken by industrial leaders in the national campaign for the control and prevention of the venereal diseases, syphilis and gonorrhea.

Industrial leadership is not the attribute of any particular city or state, but business executives, when it comes to a question of spending money, are almost unanimous in being "from Missouri." Their "show me" challenge was difficult to meet in former years, as venereal disease data presenting industrial wastage had not been compiled to any great extent. The records of the army since mobilization now remedy this defect to some extent, and give statistics on which fair estimates may be based. Practically all of the venereal infections in our national cantonments were contracted in civilian communities, more than two-thirds of them before the infected men were inducted into service. The draft army was composed of men taken directly from all strata of American life — the same men who make up a great percentage of the industrial army. The following facts and figures on the prevalence and seriousness of the venereal diseases in the army are, therefore, most pertinent to the question of the prevalence and seriousness of these same diseases in the industrial world.

Of the 967,486 men in the group known as the "second million," there were 54,843, or 5.6 per cent., infected with a venereal disease. The annual report of the Surgeon General of the Army for 1919, in comparing these figures with those for the first 500,000 and first million, says, "It is probable that the figures for the second million of 5.6 per cent. showed more clearly the correct percentage of the drafted men from civil life who were infected." During the year 1917, gonorrhea was the commonest cause of admission to sick report among soldiers in the United States and in 1918 was second only to influenza. In 1918 syphilis, gonorrhea and chancroid together were second only to influenza in number of admissions, exceeding by 87,871 admissions bronchitis, the next most frequent cause. Hence, it is evident that, with the exception of the unusual epidemic of influenza which prevailed in 1918, venereal infection was the greatest cause of disability in the army during the world war. The two years 1917 and 1918 witnessed the entrance of approximately 3,500,000 men into the army by induction or voluntary enlistment. In these two years the total time loss to the entire army from venereal disease was 4,825,661 days — 2,412,830 days per year. A low estimate of

* Received for publication April 16, 1920.

the number of men employed in the United States in manufacturing industries alone, today, places it at 10,000,000. Based on the above army figures the yearly time loss through venereal disease in this one group of industries is 6,893,800 days. As for the actual financial loss it cannot be approximated since this would necessitate figuring in the time lost through such complications as gonorrheal rheumatism and the various syphilitic conditions, decrease in working activity, and increased liability to accident.

These army statistics cannot be applied literally to industry, as treatment was obligatory in the service and men were withdrawn from the ranks for longer periods than they would be absent from business. The figures indicate, however, a fair estimate of time necessary for thorough treatment. Then, too, it must be understood that while a worker would not always be actually out of employment ten days, as in the army, he would nevertheless be ailing and non-effective in his work to a far greater extent than the army's ten-day average represents. The necessity for frequent micturition, the inability to keep mind and body "on the job," the constant tendency to "ease up" — these, together with the actual time taken off for treatment and that spent in bed, either at home or in a hospital, are elements to be taken into account. It would, consequently, be fair to consider these factors in estimating the loss of time. It is not possible to compute with accuracy the extra compensation paid to employees by insurance carriers for the delayed recoveries from accidents where syphilis and gonorrhea are contributing agents, but this too is an important factor to consider.

The plant surgeon of a large steel company relates the following instances:

Case 1. — A heavy man turned his ankle in making a misstep. After being sent to the hospital an X-ray was taken. It was negative and the injury was diagnosed as a sprained ankle. Ordinary time for recovery would have been four to six weeks but, owing to latent syphilis, this man was compensated for seven months before he was able to return to work. The slight injury stirred up this syphilis and the resulting complication increased the expense to the insurance carrier from \$72.15 (which would have been the compensation had the disability lasted the ordinary period of six weeks) to \$336.

Case 2. — An employee in the course of his work sustained a fracture of the lower third of the femur (thigh bone). In April, 1918, one year had elapsed since the accident, but the fracture had not united and the man was still on crutches. The insurance carrier had paid one year's compensation besides the first two weeks' medical service. Figured at the lowest rate this would have amounted to \$260, plus a two weeks' hospital bill. If the company had been able to stop payments then, it would have done its full duty as, in one year, a fractured femur should be united and the patient back at work. As in Case 1, syphilitic complications were responsible for the delay, but in Case 2, "The chances are very much against his *ever* recovering sufficiently to work," hence the insurance company must continue paying his compensation.

To combat this venereal disease menace, hundreds of the nation's greatest business organizations have joined in the industrial campaign now being carried on under the leadership of the United States Public Health Service, the U. S. Interdepartmental Social Hygiene Board, state boards of health, and the American Social Hygiene Association.* These public organizations are co-operating in the establishment of clinics and in the dissemination of rational health education, while the American Social Hygiene Association, as a civilian agency, is giving the program its full support, its endeavors being directed more particularly along the educational line.

* The Division of Venereal Diseases, United States Public Health Service, 228 First Street, N. W., Washington, D. C., will furnish you with full and complete information on clinics and will co-operate in their establishment.

The American Social Hygiene Association, 105 West 40th Street, New York City, working with them, will provide at cost forceful, up-to-date educational material — material which has already been used to great advantage in hundreds of the nation's greatest industries, such as the Phelps Dodge Corporation, the Hercules Powder Co., the DuPont de Nemours Co., Kelly-Springfield Tire Co., Emergency Fleet Corporation, Westinghouse Electric Co., etc.

The first question asked by an executive is, "How best can industry co-operate in the campaign?" An authority on industrial hygiene answers this as follows:

> First, by seeing that the community has treatment facilities in the form of a venereal disease clinic as part of (1) a general dispensary connected with a hospital, (2) a health center doing treatment work, or (3) an isolated clinic under official (health department) auspices.
>
> Second, by doing educational work within the plant. In this connection one plant doctor claims that far better results can be secured by subsidizing local public clinics for treatment purposes than by spending the same amount for a plant venereal disease clinic; then placarding the plant extensively and distributing educational material to the employees.
>
> Third, by providing better environmental conditions and more wholesome recreational facilities.

The foundation of the whole campaign is the public health equipment of the community. It is essential that this be in condition to function, for education and recreation cannot do a complete job without it. In fact some educational campaigns have failed because local clinics, when confronted with a large number of new cases, have curled up and died.

A second question usually asked by the executive is, "Will the clinic be extensively patronized?" Health officials answer this in the affirmative on the following grounds: Oftentimes the men have been cheated by quacks: others have gone to ethical doctors who have proved incompetent in the diagnosis and treatment of venereal cases. Many, to their sorrow, have experimented with "3-day" gonorrhea cures and other over-the-counter nostrums. When they learn, therefore, that their own plant is co-operating in a great national campaign to provide adequate medical facilities under skilled supervision, they are quick to take advantage of these facilities. Any idea that the owners or executives have ulterior motives in aiding this movement has been thoroughly removed by the knowledge that the government has asked their aid and that the American plan for controlling and preventing venereal diseases has been endorsed by the American Federation of Labor. Under no circumstances, however, should the clinics be designated as venereal disease clinics, since the natural effect of such designation is bad. Venereal cases should be so handled that no greater publicity is given them than is accorded any other ailment.

A few actual examples of work already accomplished will emphasize the need for and value of these measures. A northern New York firm having 3,000 male employees followed the government's suggestions and adopted educational and clinical measures. Thirty cases applied for treatment within the first few weeks. One man had spent $800 for quack treatment, which, as is usually the case, had failed to provide the promised cure. By placing the case in the hands of a competent doctor and expending $50, the company brought about his cure.

An influential manufacturing concern in West Virginia followed the advice of a health expert and aided in installing a clinic for the free treatment of venereal disease at a cost of between $5000 and $6000 for the first year. The plant had a payroll during this period of $125,000. The president of the firm has informed the United States Public Health Service that as a result of the clinic treatment, labor efficiency was improved $33\frac{1}{3}$ per cent., which gave him a return of $40,000 from the investment.

A corporation, among its other activities, built a city in a wilderness for the housing of thousands of men and women employees. When efficiency dropped below expectations the officials sent experts to conduct a survey and find the cause. This investigation showed:

1. That one employee in every ten had a venereal disease.

2. That 68 per cent. of non-effectives were on the non-effective list because of venereal disease.

3. That every person who had a venereal disease lost three times as many hours from work as the person not affected.

4. That it cost every person so afflicted $75 per year for treatment; a total of $50,000 for treatment, with a loss of time greatly exceeding this amount.

This survey convinced the officials that it would repay them to take steps for remedying the situation and they asked the United States Public Health Service for help. An immediate response was forthcoming and co-operation given toward the establishment of clinics where the employees could be treated. In a comparatively short time the cost of operating the clinics was entirely offset by increased production.

It is not an uncommon thing nowadays for groups of industries to combine in making an adequate appropriation for the local health department to work with. They are realizing that disease cannot be controlled from within the plant but that certain helpful measures *can* be carried on therein. These general truths apply specifically to the fight against syphilis and gonorrhea, a public health campaign presenting the opportunity for a combination of true altruism and good business judgment.

Summary

1. Army statistics, being fair and comprehensive, form reliable grounds on which to base estimates of loss to industry through the venereal diseases.

2. A conservative estimate of the number of cases in the 3,500,000 men, drafted and enlisted, who were in the army during 1917 and 1918, shows 5.6 per cent. infected with a venereal disease. Excepting the unusual incidence of influenza, the venereal diseases accounted for more men on sick report than any other disease.

3. It is impossible to estimate with accuracy the loss due to such causes as rheumatic and other venereal disease complications, frequent micturition, decreased efficiency, increased compensation payments necessitated through slow healing of wounds, etc.

4. Industrial aid in controlling venereal diseases can be made most effective through financial and moral assistance to local public treatment facilities rather than through plant clinics. Much may be accomplished within the plant, however, through placarding and the distribution of educational material.

5. Several demonstrations have proved that a reasonable appropriation for fighting these diseases will more than pay for itself in increased efficiency and lessened labor turnover.

THE MENTAL HYGIENE OF INDUSTRIAL WORKERS*

CARL SCHEFFEL, Ph.B., M.D.

American Can Company of Massachusetts

THIS important topic involves such a broad scope that it is impossible to give more than scant consideration to it in an article of this length, and only a general concept of the mental hygiene of the industrial worker is reviewed.

The social and economic customs of our present standards of so-called civilization making it necessary for the average individual to toil for his existence at an early period in life, it becomes at once apparent that a slight understanding of man's attitude towards compulsory labor is of value in tracing his mental reactions to various kinds and grades of labor. The primary and paramount object of the average industrial worker is to get as much remuneration for his services as is possible; and that of the average employer is to get as much service as possible for the remuneration he gives. These are the two opposite extreme mental aims of employee and employer — notwithstanding all statements to the contrary — and it is this mental attitude which causes the existing wide gap between capital and labor. From the very commencement of his industrial life the future worker has instilled into him these fundamental relationships between himself and his employer. Parents seek to place their children at work which brings the largest financial rewards in the shortest possible time. The average future industrial worker is initiated into industry not with a mental concept of endeavoring to determine how much good he can do to the advancement of mankind, but how much money he can get for what he does. Under these conditions it is easily understandable that the mental hygiene of the industrial worker is of the utmost importance to the worker himself, to his employer, and to society in general. At the present, the mental hygiene of many industrial workers, especially of so-called organized labor, is in a distinctly unhealthy state. Unfortunately industry is as much to blame for this condition as is labor. Employers who pay no attention to the mental hygiene of their workers will eventually pay the price for their negligence. Industrial mass-mind not kept clean, busy, and amused will soon decay, and as the result of this decay discontent, strikes, and riots are bred. Few large industrial plants which have provided active welfare movements based upon a careful study of the psychology of employees have had to confront serious labor difficulties in the present acknowledged industrial turmoil.

Industrial workers absolutely require rest, recreation and mental tranquility for that stable mental equilibrium which brings forth their greatest powers of productivity and keeps them satisfied workers. The nature of the various kinds of industrial labor is almost as varied as are the industries themselves, but practically all work may be grouped into four chief categories; namely, skilled and unskilled, monotonous and diversified. All work carries with it mental and physical reactions, and it is the nature of these reactions which make work a pleasure or a burden. Let us therefore briefly note the psychic effect upon the worker of various kinds of labor. By psychic effect I mean the reaction of the emotions, moods, and other mental processes to labor; I do not mean the reactions

* Received for publication April 17, 1920.

produced upon mental processes by a physically overworked body which may, for our purposes, be considered abnormal.

As a rule, skilled work carries with it a certain degree of mental satisfaction which to a large extent overcomes any disagreeableness associated with its performance. An engraver may have a most nerve-racking time in cutting a difficult scroll upon a hard piece of metal, but when the task is completed he is possessed of the mental satisfaction of seeing a difficult job well done, and is also in possession of a conscious or unconscious sense of mental exhilaration which greatly relieves the after-effects of the nervous tension under which he may have been laboring for days previously. An automobile mechanic may spend hours of time in vainly endeavoring to start a balky engine, but when he has accomplished his task his mental tension is greatly relieved and the unpleasant effects which usually follow such tension are thereby greatly diminished. Mental exhilaration is an accompaniment in various degrees and forms of most skilled constructive labor. There are other forms of skilled labor, however, such as bookkeeping, accounting, etc., where the result of mental tension is only rewarded by a sense of relief that the task is done; there is not that sense of satisfaction accompanying many kinds of clerical work which comes from the ability to look upon a finished piece of work, the construction of which may be seen by others as well as by the worker himself. In other words, work which shows no material results visible to everybody is not apt to carry with it the mental satisfaction accompanying visible construction.

Much of the unskilled labor of our industries, on the other hand, is monotonous, uninteresting and fatigue-producing. Such work carries with it little or no mental satisfaction and consequently may, and often does, carry the worker into one or two channels of mental inertia. The worker, finding no mental stimulus in his work, very often becomes a mere automaton; his mind wanders from topic to topic, and, if employed at mechanical labor, he easily becomes the victim of industrial injury due to inattention. Day dreamers are made of thousands of industrial workers through lack of mental stimulation during working hours. Many of these workers get duller and duller as the time goes on so that to a certain degree they become near-morons according to mental classification. Mental monotony to the extent of allowing habits of introspection to form is one of the greatest banes to industrial workers, and should be made the subject of special study with a view to diminishing its frequency. Table 1, taken from an interview of thirty-one workers between the ages of 16 and 51, consists of replies to the simple question of "What are you thinking about at the

TABLE 1. — REPLIES TO QUERY, "WELL, WHAT ARE YOU THINKING ABOUT?"

Sex	Reply
Male	Phonograph records out for March
Female	Pain in her tooth
Female	How many covers she had made
Female	Thinking about sick child at home
Male	What work he will be put on after this job is done
Female	Whether or not she would go out to-night
Female	Thinking about forgotten door key
Female	That she had not received a cut for a long time
Female	Whether or not I would speak to her about not wearing a cap
Male	Says he is thinking about nothing in particular
Male	Thinking about forthcoming prize-fight
Female	Thinking about a dance she is going to to-night
Female	Thinking about pain in her foot
Female	About some work she spoiled and for which she was reprimanded
Female	About going somewhere to-night
Female	About getting a new suit
Female	About some altercation she had with a co-worker
Female	The slowness of her partner at work
Male	What time of the day it is
Female	How she is going to get home without rubbers
Female	Of the whereabouts of a friend
Male	About getting a haircut before going home
Female	About how painful a cut is which she received
Female	Whether it will clear up or continue to rain

moment ?" The workers interviewed were all sufficiently acquainted with the interviewer so that the question caused no surprise or other serious mental reaction. In fact the query was made at a time when the workers were in their most familiar surroundings — namely, at their work — and the question was put in a casual manner only to those who had become familiar with the questioner through previous relationship as physician and patient. While it is true that simple replies to a simple intimate personal question may not represent the actual thoughts in these workers' minds at the time, nevertheless I believe that the majority of replies were made in good faith — an opinion based upon the truth of other statements by these same workers in past dealings with them.

Undoubtedly some of the thoughts expressed were aroused by the associations which some of these workers had with me as the result of slight injuries, while others may have been brought about by similar thought associations. Out of all the replies, it would seem that only three related directly to the work which was being done. Only one person stated that he was thinking about nothing in particular, which of course, strictly speaking could not have been true. The chances are that he did not care to state what he was thinking about. Most of the replies indicate clearly enough that the minds of these workers were upon almost anything but their work, and when consideration is taken of the fact that the great majority of the workers were operating dangerous machines at the time, it becomes evident what a source of danger mind-wandering really is. To illustrate how far some industrial concerns have gone in attempting to break the monotony of certain work and in trying to keep the employees' minds centered in the activities of the factory surroundings, one shoe factory has had a victrola mounted upon wheels, and this is carted from department to department playing popular music to break the monotony of the work.

Industrial workers, whether skilled or unskilled, all require three cardinal processes to rejuvenate their sapped vitalities from day to day. These are: physical exercise, which brings into play those muscles not used during the daily work, mental recreation, and a good night's sleep. Upon the varied application of these cardinal points rests the secret of industrial efficiency and contentment. First, let us consider physical exercise. The average industrial worker will probably try to make you believe that he gets all the exercise he requires out of his work. This is, as a rule, not the case. Most active exercise in connection with industrial pursuits calls into play only certain muscles, to the neglect of others, thereby creating an unevenly developed musculature. We cannot have a healthy mind without a healthy body, and it is, therefore, of importance that the physical well-being of the industrial worker be kept as nearly perfect as possible if we would have him enjoy a good state of mental hygiene. The kind of physical exercise in which the industrial worker should indulge depends entirely upon the nature of his work. While almost any form of exercise is good, out-door exercises are best. Group exercises are better than those practiced in private. Games, calisthenics, etc., in which large numbers may participate, carry with them a certain degree of mental stimulation in addition to the pure physical exercise which is of especial value to the industrial worker. Unfortunately, however, the predominating exercises stimulated in many industrial plants are base-ball, foot-ball, and other team contests where the minority get the benefit of the exercise while the great majority do the looking on. Sports where large numbers may participate should be popularized to a much greater extent for the benefit of industrial workers.

Exercise, like all other good things, may be overdone. The industrial physician is very often consulted for the relief of the effects of a holiday of such strenuous exercise that the worker becomes less efficient in the performance of his duties until the soreness is relieved. The ideal manner in which to control exercises for industrial workers is by having them under the direct supervision of a physical director employed for the purpose. If more reliable statistics were available, there is little doubt but that most industrial concerns having well-organized systems of providing systematic exercise for their employees would show a decrease in time lost from illness as compared with less progressive plants. In attempting to obtain actual figures to prove this contention, considerable difficulty was encountered. In the first place, many employers who have gone to the expense of employing physicians or nurses have no knowledge of the time lost through illness in their plants. Then again others were encountered who did keep a record of time lost from this cause but who had no means of providing systematic exercise for their employees. After considerable difficulty Table 2 was compiled, and, taking into consideration the present dearth of records of sickness-loss in most industries, there is every reason to believe that it is as correct as any figures compiled from mixed sources.

TABLE 2. — EFFECT OF EXERCISE ON TIME LOST FROM ILLNESS

Industry	Per Cent. of Employees Ill All of the Time	Per Cent. of Employees Indulging in Systematic Exercise	Per Cent. Ill All of the Time Among those Exercising Regularly
Paper goods	4.76	6.5	3.83
Machine parts	6.43	42.0	4.09
Textiles	7.79	14.0	4.41
Shoe industry	4.93	7.0	4.33
Food products	3.8	72.0	2.64
Life insurance office workers — physical examination required	3.21	84.0	2.14

Five gymnasium classes, comprising three for males and two for females . .	Annual percentage of illness in those who study (Male)	1.73
	Annual percentage of illness in those who study (Female)	2.04
	Annual percentage of illness in those who work (Male)	1.83
	Annual percentage of illness in those who work (Female)	2.17

The first thing of importance which strikes one as a result of a study of this table is the high percentage of illness among these workers in general. It is conceded, I believe, from exhaustive statistics compiled that only between 2 and 3 per cent. of the American population have been found to be ill all of the time. The higher percentages in this table are probably due to the comparatively small number upon which these figures are based, or due to the time at which these figures were obtained. Roughly speaking, the industries included in this table employ altogether about 16,400 workers, the largest single plant being in the textile line, and the smallest in the insurance business. The table was computed from figures submitted during the first three months of the year when illness is apt to be more frequent than at other times, and since two of these six industries submitted figures based upon the percentage of illness at the time of query instead of on the annual loss from this cause the chances are that these figures would average a little lower for the year round. Out of 16,400 workers — of whom about 37 per cent. take systematic exercise — the difference in percentage of constant absence from illness among those who systematically exercise and among those who do not is 1.611 per cent. In other words, out of about 6100 industrial workers who exercise regularly, there are about ninety-seven less on the constant sick list than among those who do not exercise systematically. These figures roughly demonstrate the value of regular exercise for industrial

workers, and if more extensive and accurate figures were available there is little doubt but that far greater benefits would be shown. The list of pupils of gymnastic schools and organizations has been appended to the table for the purpose of making a comparison of the effect upon health of exercise taken under expert supervision and that taken without expert guidance. The ages of those attending gymnasium classes average very closely to those of the industrial workers taking exercise without expert guidance, so that it can hardly be said that the low rate of illness among members of gymnasium classes is due to their being younger. The very low illness rate among members of gymnasium classes, even among those who must do their exercising after a hard day's work, should be of sufficient interest to warrant further investigation from every employer of labor who has efficiency and production at heart.

Next to the physical well-being of the industrial worker, there is nothing more important than his mental contentment. All work and no play is not conducive to the best interests of the worker. Exactly what is required for the contentment of the worker is an individual problem, but all industrial workers require recreation. In guiding as much as possible the recreational activities of his workers, the employer goes a long way towards creating contented workers. Workers will, to be sure, seek and find recreation of their own accord, but like physical exercise, their recreation is often apt to be misdirected from the point of view of their own best welfare. Then again, what is recreation to one may seem drudgery to another. The industrial worker who does hard physical labor all day seeks a far different form of recreation than the man who toils mostly with his brain. While individual tastes undoubtedly play an important rôle in recreational activities, and even though recreation is a voluntary act, this by no means precludes its being wisely directed. Employers in many large industrial plants located in suitable communities have completely altered the recreational habits of their employees through patience and well-directed welfare movements. For instance, the dance hall, which forms the chief recreation of thousands of young industrial workers, may be transformed from a cheap ill-conducted place where both the physical and moral health of the workers is impaired into a place of wholesome recreation, devoid of all ill after-effects. Organizations employing much skilled labor, whose advancement depends upon educational preparation, have found it profitable to themselves and to their workers to conduct semi-social gatherings after working hours in which both recreation and education play a part.

The entire range of the mental hygiene of the industrial worker revolves about a psychological axis as its center. The worker who spends eight or more hours a day at industrial work requires a daily change of thought, change of scene and change of routine in order to keep his mind from entering upon a path of dissatisfaction. Habits of introspection, while valuable enough for scientific purposes, are as bad for industrial workers to indulge in as they are for hypochondriacs. This being a materialistic rather than an idealistic world in which to live, it is but natural that the industrial worker should most easily follow lines of thought leading him into an attitude of self-pity and dissatisfaction with his lot. These lines of mental activity when indulged in by mass-mind lead toward the road of industrial unrest. The mind of the worker should be kept clean at all times, and this ideal can only be approximated if the mind is kept active along proper channels. Just because a worker may have been engaged in hard mental labor all day long is no reason why

his mental activities should absolutely cease after working hours. Every bodily function is normally rhythmic and there is reason to believe that psychologic functions should also be carried on in a rhythmic manner. In exercising the mind, as in exercising the body, after working hours those parts should be brought into activity which have been inactive during working hours. The industrial worker, as well as any other worker, uses his brain constantly. His train of thought is apt to be far away from his work, as is shown in the list of answers to our query as to what was being thought of at the moment. His thoughts may not be profitable to his employer, but his mind is working in a sort of day-dreaming fashion just the same. To keep the worker's mind equally or more active during working hours along constructive lines of thought should be the aim of every employer, and if successfully carried out will result in a better balanced mentality, beneficial both to the employee and to his employer.

One of the most commonly used methods of attempting to create contentment in industrial employees is to hire them with either a promise of, or allusion to, opportunity for advancement. This method, there is some reason to believe, is being used too often in an insincere manner. To give an employee the impression that advancement awaits him, when in fact there is no such bright opportunity in sight, is only fooling him for a certain length of time; such a method reacts as a breeder of discontent and becomes a cause of increased labor turnover. It would seem far better to keep the mental expectations of an employee up by letting him have a taste of something better which may be in store for him when the opportunity arrives. There are but few lines of work where it would be impossible to teach a worker the duties of the man superior to him; such a procedure encourages the employee greatly to look forward to something better, it actually prepares him to fill the position of his superior, and in case of emergency gives the employer the benefit of continuing uninterrupted activity by having two men trained for one job. In dealing with the mentality of industrial workers, as in many other things, deeds make a far deeper impression than do mere words.

Next in importance to a physically healthy body and mental contentment for the industrial worker is a good night's sleep. The human economy absolutely requires a fair amount of sleep for its repair and restoration from day to day. While there is undoubtedly a great variation in individual requirements as to the amount of sleep necessary to bring about rejuvenation of vitality expended during waking hours, it is, nevertheless, a fact that probably most workers under the age of 30 get too little refreshing sleep on six nights of the week. This state of affairs is due partially to our social system of recreation, and partly due to economic and racial conditions. Nowadays many of our young industrial workers do not get sufficient sleep because of late dances, theatre parties, midnight suppers, and the like. This is by no means theory, but fact which may be easily proven by frequenting the amusement places patronized between the hours of 10 and 12 by our young industrial workers. It very often happens that when these workers do get to bed they sleep amid unhygienic surroundings, and the wonder is that they stand up as well as they do.

While unhygienic personal habits are partly due to economic conditions, racial peculiarities also play an important part. Many industrial workers whose incomes far exceed those delegated to inspect their living conditions, live amid unhygienic surroundings. With the present inflated wage scales it is not uncommon to find a professionally trained person whose duty

it is to investigate the conditions of tenements — a person whose income is considerably smaller than those of the workers inhabiting the tenements. Yet, notwithstanding this fact, the investigator would not think of living under the conditions he sees in his daily work, and this despite his smaller income. Unhygienic living conditions, which undermine both the physical and mental health of the workers, are very apt to be due to lack of education or to lax public health supervision rather than to economic conditions. A worker appearing in the morning after a night of insufficient or restless sleep is apt to be irritable in mind and slow in movement. He will almost certainly be less productive and is peculiarly susceptible to industrial injury. A good night's sleep is just as essential to the worker as a good meal, and it behooves industry to aid him in every way possible in obtaining it.

The various methods by which employers may prevent their workers from getting into ruts of mental decay ean hardly be put down in the form of set rules or directions. Each employer in each industry will meet problems peculiar to his own plant and to his own employees. That the mental hygiene of industrial workers ought to receive more attention than it does at present is conceded by many, but how to keep the psychologic state of industrial mass-mind in good form for efficiency and contentment are as yet unsolved problems. A beginning along these lines has been made, and it is earnestly hoped that as time goes on more attention to the mental hygiene of industrial workers may be paid by the industries. The reward therefor will be diminished labor turnover, less industrial unrest and increased production, to the great benefit of the industrial worker himself and of society in general.

AMBULANCE AND FIRST AID*

JOHN C. BRIDGE, F.R.C.S., Ed.
His Majesty's Medical Inspector of Factories

PERHAPS nowhere is the old adage regarding the happening of accidents better exemplified than in factories. Where the human element is a contributory cause, accidents will happen at one time or another in spite of all precautions. The Welfare Orders dealing with ambulance arrangements and first aid issued by the Home Office under Section 7 (2) of the Police Factories, etc. (Miscellaneous Provisions) Act, 1916, are issued to reduce the consequences of accidents. The two fundamental principles of these orders are first to treat all wounds, however trivial, so that the workman may quickly return to his work in comfort and safety, and secondly to prevent, as far as possible, serious accidents from becoming more severe.

Records of accidents over many years have shown that it is not always the severe accident that in the end proves the most serious; loss of a limb or even of life has followed apparently minor injuries, so trivial in fact as to encourage neglect when first received. By neglecting wounds such as these and continuing at work the worker runs the risk of blood poisoning. The main objects aimed at in the orders are, that the treatment shall be immediate, simple of application, and that the dressing applied shall reduce as far as possible all risk of infecting the wound. Great importance is attached to immediate treatment; the longer a wound, even a very small one, remains untreated, the greater is the possibility of infection. Simplicity enables a large number of persons to be instructed easily in the method and use of a first aid dressing, while a sterilised dressing, which can be applied without that part which is to cover the wound being handled, reduces the possibility of infecting the wound to a minimum. A reduction of approximately 50 per cent. in the number of septic cases has been reported in one factory after the introduction of the first aid boxes.

These are the principles which underlie the first aid orders and apply in particular to the first aid boxes equipped with sterilised dressings, which have to be placed in the works themselves and in positions within easy reach of all the persons employed. The dressings, in addition to being packed so that they remain sterile, should also be of such a character as to be suitable for the injury for which they are intended to be used. The orders require a certain number of dressings for the finger, hand or foot, and large dressings for other parts of the body. Since the issuing of the orders many first aid boxes have been seen in the factories visited which, although they fully comply with the letter of the requirements, fail to provide the most suitable or convenient dressing. This defect has been observed especially in the case of the small dressings for the finger which, generally speaking, have been too bulky and put up in such a way as to make their successful application difficult. In August, 1917, a conference was held with the principal manufacturers of surgical dressings at which the nature and quality of sterilised dressings was fully considered. A further conference was held in June, 1918, at which the question of standardization was discussed. Experience will necessarily suggest modification and improvement in the detail of the dressings, and no doubt suitable dressings for all requirements will

* Reprinted from the Annual Report of the Chief Inspector of Factories and Workshops, Great Britain, for 1918.

ultimately be designed; but this result will be more quickly attained when those interested emphasize their requirements and their objections to the dressings at present supplied. Considerable progress has been made, and great improvement in this direction may be looked for in the near future.

The inconvenient character of some of the sterilised dressings sent out in the first aid boxes has been one of the hindrances to reaping the full effect of the orders requiring their provision. Even when the required sterilised dressings have been supplied, the use of rolls of unsterilised lint or gauze, generally not too clean, has been continued, partly owing to the ease with which a dressing of a convenient size can be cut off and applied. Inability to appreciate the value of a sterilised dressing and the possibility of applying such a dressing satisfactorily in a factory, due to want of training in its use, has also retarded progress.

A course of instruction in first aid on somewhat new lines, arranged by and under the supervision of Dr. T. W. Woodhead, of the Technical College, Huddersfield, has been successfully commenced in that town. The course is divided into two parts, elementary and advanced. The former is limited to instruction in the use and application of the first aid dressing and such treatment as can be carried out in the workroom or at the first aid box. The advanced course deals with first aid generally, and as the syllabus is approved by the St. John Ambulance Association, those taking the full course are qualified to enter for the examinations of the association. A feature of this course, in so important a centre for the manufacture of dyes, is the attention paid to gassing accidents.

It is not generally realised that wounds, which require treatment other than the application of a sterilised dressing, are not of a nature that can be successfully dealt with in the workroom, but need to be sent on to the ambulance room, hospital, or doctor, for the more complicated forms of treatment. In such cases, however, the immediate application of a sterilised dressing from the first aid box lessens the risk of infection of the wound while the worker is on his way to the ambulance room, hospital, or doctor, and the first aid box continues to be a valuable addition even where an ambulance room is provided in the works. The washing of wounds, which is lightly undertaken by many imperfectly trained persons, often with hands far from clean, is in itself a minor surgical operation requiring technical skill and training, if the injured person is not to be subjected to added and unnecessary risk. For this reason, the treatment of minor injuries recommended does not include washing the wound; and the removal of dirt is limited to applying iodine solution to the wound, which is generally all-sufficient for cases such as it is contemplated will be treated at the first aid box.

Where there is no ambulance room, many firms have provided additional equipment in the form of splints, tourniquet and the like for one of the first aid boxes for use in an emergency, until the injured person can be removed elsewhere. In one factory a well equipped first aid dressing station, the size of a telephone cabinet, with stretcher, chair and other additional equipment has been provided; such arrangements are useful and are recommended in similar circumstances.

The equipment for first aid boxes in the Welfare Order dealing with dyeing and tanning by a solution of bichromate of potassium includes, in addition to sterilised dressings, collodion and waterproof plaster. It has been found in several instances that the plaster supplied has not been of this nature. It is very important that effective plaster, viz., plaster waterproofed on the outside, should be provided in order to prevent the solution saturating the dressing

and in this way attacking the injured part.

An ambulance room is required in factories employing 500 or more persons, which come within the scope of the First Aid and Ambulance Order. This of itself emphasizes the intention of the orders that only minor injuries should be treated at the first aid box, as it is considered that the number of more severe cases which will occur when 500 persons are employed will be sufficient to warrant the provision of such a room, instead of sending such cases elsewhere for treatment.

The suitability of the ambulance rooms provided in the factories has been found to vary very considerably, many of those recently built leaving little to be desired. In one engineering works two large rooms communicating with one another, one for men and one for women, have been built. A rest room next to, and communicating with, the woman's ambulance room, as well as a men's waiting room is also provided. Each ambulance room is lighted on one side with ordinary casement windows, and on the other side large plate glass windows are fitted above the doors and occupy the greater part of the wall space to the ceiling; the light thus provided is excellent. The floors are of terazzo over cement and the walls and ceiling of parian cement covered with washable enamel; all corners are rounded and the woodwork white enamelled. Each ambulance room is fully equipped with an electric instrument steriliser, cabinet, dressing wagon, screen, table, chair and couch, a surgeon's sink and a lavatory basin of good design, the supply pipes to these fittings being enclosed. All woodwork is white enamelled.

Many ambulance rooms have been converted from rooms previously used for other purposes, and, although not equal to the ambulance room described above, provide in many instances good accommodation. In some, however, the lighting and ventilation is defective; in others the wooden floors and wooden panelling of the walls are difficult to keep clean; consequently, the result is not always entirely satisfactory. There is no doubt that for quiet and cleanliness the ambulance room should be well separated from the workrooms. Where the sanitary conveniences are not near the ambulance room, a special water-closet is necessary. In some cases this has been provided by cutting off a corner of the ambulance room by a partition — in a few instances not extending to the ceiling. In neither case is the arrangement satisfactory, the latter being particularly objectionable. The convenience should be built outside the ambulance room, and, wherever possible, with an intervening ventilated space.

The person in charge of the ambulance room should have considerable experience and training in the treatment of wounds. The scope of treatment given in the ambulance room must vary with the standard of training and qualifications of the person in charge, and this has generally been found to be the case. A fully trained nurse is able to deal with the more serious cases as well as with the redressings of old cases which are beyond the capacity of a person with certificates of first aid only. The training for these certificates lays stress upon the importance of referring all cases treated to a person with greater knowledge. In some instances persons have been found in charge of the ambulance room who by their training are only qualified to render very simple first aid, but who, nevertheless, attempt other treatment which they are incompetent to carry out correctly. The term "nurse" is used very widely and includes many with little or no training in dealing with wounds. Mental or maternity training, home nursing, or even less, appears to qualify for the title of "nurse" as soon as the uniform is put on. Fully trained nurses are now employed in many factories, and the advantages of their services not

only in the ambulance room but also in the general supervision of first aid through the factory have been apparent.

The difficulty of appointing fully trained nurses to take charge of ambulance rooms in smaller works is a real one, but this has been overcome in Sheffield by several firms, whose works are adjacent, joining together and employing a highly trained nurse who visits the ambulance rooms at appointed hours, redresses old cases, and sees all cases referred to her by the first aid attendants. The scheme so far works well and is one that is worthy of commendation under similar circumstances.

The orders have, on the whole, been appreciated; objections to them have been chiefly against the introduction of the first aid boxes in factories where an ambulance room is provided. This is almost entirely due to failure to understand the purpose for which the boxes are intended, viz., treatment of minor injuries, and protection against infection in the case of serious accidents requiring treatment in the ambulance room. Unauthorised interference with and pilfering of the contents of the boxes has also added to the difficulty. This interference is in a large measure due to a lack of interest in the first aid, and want of organisation of this work in the factory. Generally speaking, the interest taken by the workers in first aid is considerable, and only requires stimulation. The interests of employers and employees are identical where first aid is concerned, and the absence of any organisation in nearly all the factories visited, which it is believed would enormously increase the benefits of the first aid provisions, is to be regretted. With the formation of safety first committees, a way should be found to remedy this defect by the formation of a sub-committee to deal with all matters concerning first aid, to undertake arrangements in connection with the training of persons in the application of a first aid dressing, and to appoint the persons responsible for each first aid box. Each of these persons, with more advanced training, might also act as the captain of the squad trained to render the very simple first aid in his department of the factory. The sub-committee would also deal with any representations made regarding the suitability of the position or contents of the boxes and would also take cognisance of pilfering and all other matters concerning first aid. To advise the sub-committee, the services of a medical man in touch with the works — the certifying surgeon, for instance — might most usefully be retained. Reports of all accidents, however trifling, should be submitted to this sub-committee, who would refer cases of abnormal incidence of accidents in particular departments or occurring on particular machines to the full committee. The information so obtained should prove of very practical value and should emphasize the importance of keeping records, with full particulars, of all cases.

These suggestions indicate the lines upon which an organisation of first aid in factories might be brought about, and without which it is felt the benefits of the first aid provisions will never be fully obtained.

MERCURIAL POISONING IN THE MANUFACTURE OF CLINICAL THERMOMETERS *

WILLIAM JACOBSOHN, M.D.

Industrial Medical Inspector, Division of Industrial Hygiene, Department of Health, City of New York

THIS paper describes the processes of thermometer manufacture as seen in individual shops, together with hazardous conditions that have been found; cases of mercurial poisoning that have occurred in the shops are described; and finally preventive measures that have been recommended for safeguarding the health of the workers are given.

Clinical thermometers are made from rounded strips of glass with a central bore — strips cut to the required length. Each of these strips or stems is opened out to form the blister by means of a gas flame and air pump, and the bulb is then blown. The next process is that of filling the bulb with mercury heated by a Bunsen flame; then follows testing by standard comparisons. The tops of the stems are next sealed, the blister is contracted, the heads are rounded off, and the thermometer is engraved.

In one of the factories that I recently surveyed and in which a worker had been affected with mercurial poisoning, I found the following conditions: All windows were closed. Over the places where the bulbs were being filled with heated mercury, volatilization of the mercury took place. Hoods had been placed here, but served no purpose, as they were neither enclosed nor connected with the outer air, and therefore did not prevent inhalation by the workers of the mercurial vapor. During the process of testing, mercury was brushed off into the workroom and upon the work benches and floors where it lodged in cracks and crevices. Under the influence of the warm and moist atmosphere of the room, the spilled mercury was volatilized and inhaled. The heat of the room was caused by a great number of torches consisting of air and gas flames, while the moisture was caused by the heated water used for testing. No provision was made for the reduction of this excessive heat and moisture. The reason given for keeping the windows closed and for the non-connection of the hoods with the outer air was that such air would interfere with the work by deflecting the flames of the torches. These then were the conditions which favored the contraction of mercurial poisoning in this particular factory.

Other hazards, moreover, were noticed in connection with the work of this same establishment — namely, hot and bright flickering flames of the torches affecting the eyes of the workers, hydrofluoric acid irritating respiratory and conjunctival membranes during processes of etching, paint coming in contact with fingers during the filling in of the markings and graduations after engraving, illuminating gas leakage from fixtures and pipes, and glass dust scattering into the air from broken stems on the floors and tables. Washing facilities consisted of cold running water only. Street clothes were hung in the shop and were exposed to the dusts and vapors.

The following case describes the effect upon one of the employees of exposure to the above-mentioned conditions:

CASE 1. — The patient, who is 42 years of age, has been a thermometer maker for the past twenty years. He is a married man, non-indulgent in tobacco or in alcohol. His present illness began about one year ago with severe chills and tremors, pain in

* Received for publication April 10, 1920.

the gums, and occasional feeling of dizziness coming on after the tremor.

Physical examination shows a rather obese man with fairly good nutrition. His face, lips, and mucous membrane are pale and there are a few papules on the skin of his face and limbs. His eyes react to light and accommodation; his ears and nose are negative; his tongue is coated and shows a few blebs. His teeth and gums show pyorrhea, the gums being spongy, bleeding and painful to the touch. There is a slight salivation. On projection of the tongue a very fine tremor is noticed and articulation is poor. The tonsils are enlarged; the pharynx is coated and intensely red; the neck shows no tenderness nor rigidity.

The shape and size of the patient's chest are good though he is very obese; small respiratory movements are visible. The lungs are negative to inspection, percussion, and auscultation. The heart sequence is fair, the rate rapid, and the sounds weakly transmitted. The apex point is not visible nor palpable, but is faintly heard at times. The radial pulse is weak and small.

The patient's abdomen shows no tenderness nor rigidity, no palpable growth nor tumor. Percussion of the stomach gives tympanitic resonance elicited very high up towards the left chest, a region of marked obesity and flabbiness. The liver dullness extends very high into right chest; the spleen is not palpable. The kidneys, genitals, and lymph glands are negative.

The patient's extremities were fairly well developed but show a marked exaggerated tremor in the feet and hands. This tremor is an intentional one; when the patient gets up the entire body shakes, the tremor being so marked in the legs and trunk that the patient is unable to remain standing. The patella reflexes are exaggerated. When the patient is lying down the tremor disappears. A similar tremor is also present in the tongue, preventing the articulation of words. The hands and fingers are likewise affected by tremor.

The patient, while at the hospital where I examined him, showed a maximum temperature of 100° and a minimum of 99°. His pulse was 104 maximum, 76 minimum. Respiration was 30 maximum, 18 minimum. Mercury was found chemically in the urine. Urinary examination also showed many granular, epithelial, mucous, and pus casts.

In another factory, recently visited, the work was performed in two buildings. In one building, the following work was done: cutting of the glass, making the sample, making the blister, joining the bulb, filling the bulb with mercury, contracting the blister, regulating the mercury, and sealing the tops of the stems. In the other building the engraving was done in the following stages: The bulbs were dipped into the testing tank, marked with a knife, dipped in beeswax, blotted to smooth the wax, and passed through sealing and pentagraph machines. They were then dipped in paraffine, put on a rack, dipped in wood alcohol, and then into hydrofluoric acid. The bulbs were then etched, dipped into water, and laid in kerosene oil until the wax was melted. They were then taken out, placed in water, then blackened, and finally tested and certified.

In the first building there existed conditions most favorable for the contraction of mercurial poisoning. During the process of filling the bulbs, the mercury was boiled by gas and air flames and, the stems being opened, the mercurial vapor escaped. No means were taken to prevent the inhalation of this vapor by the workers. No mercury receptacles were provided to take care of the mercury that was spilled on the benches though this spilled mercury volatilizes at ordinary temperatures. Facilities for washing with hot water and soap were entirely lacking. Street clothes, hung in the shop, absorbed the vapor.

Case 2. — The proprietor of the above factory, a man of 48 years of age, had never observed any precautions though he had been engaged in making thermometers from the age of 14. In the course of his work he contracted mercurial poisoning and was seen by me at the hospital. Though his tremors started eighteen years ago, it was not until two years ago that they became so marked that he was unable to work. He has had an impediment in his speech for the past ten months, and finds it difficult to talk without great effort. His gait, however, is not staggering. On account of his tremor, he is unable to feed himself. The tremor is an intentional one — that is, there is none present when the patient is not doing anything. He has occasional very severe headaches. He smokes excessively, using fifteen to eighteen cigars a day, and is moderately indulgent in drink.

He has neither pains, numbness, tingling in the arms, hands nor legs, and no formication is present.

The patient gives a past history of pertussis, measles, parotitis, tonsillitis, and pharyngitis. His family history is negative. On account of nocturia he sleeps poorly.

Physical examination brings out the following facts: The patient's speech is peculiar and scanning; his pupils react to light and accommodation; there is slight nystagmus and no strabismus; his nose is negative. His teeth are poorly kept, with many missing, and his pharynx is congested. His ears show no tophi, no discharge nor mastoid tenderness.

The patient's chest is well developed; both sides are symmetrical and used equally during respiration. Palpation gives equal tactile fremitus anteriorly and posteriorly. The percussion note is normal over the entire chest. On auscultation the breath sounds are found to be normal; posteriorly moist râles are present here and there. Inspection of the heart is negative; palpation shows the apex beat in the fifth interspace; percussion is negative. On auscultation, the sounds indicate fair muscular quality, and are distinct. The rate is normal; there is no murmur and no arrhythmia. Examination of the patient's abdomen gives negative findings. Examination of reflexes shows increased knee jerks, cremasteric and abdominal reflexes present, Babinski absent, and ankle clonus present. There is no paralysis present in any part of the body. Sensations of temperature, touch, and pain, are normal over the entire body. The patient is markedly irritable and excited in conversation.

Laboratory examination of the urine gives the following findings: acid reaction, specific gravity of 1021, yellow color, a trace of albumin, no sugar, an occasional hyaline cast, few leucocytes, and occasional epithelial cells. The urine is negative for mercury. Colonic irrigation for mercury is positive. Examination of the stool for mercury gives a positive reaction. The Wassermann is negative. Chemical examination of the blood is negative; hemoglobin, 80 per cent.; white blood cells, 14,400. The red cells show no abnormalities. Examination of blood smears shows 65 per cent. polymorphonuclear leucocytes and 35 per cent. lymphocytes.

On seeing the patient a month after I had examined him at the hospital, I asked him how he felt. He said, "I feel like a thermometer." When I asked him what he meant, he answered, "Why in winter, I feel myself contracting. All my skin gets cold. In summer, I feel myself expanding, perspire perfusely. But I feel better in summer and much relieved." This can be explained by the fact that in winter the mercury is not eliminated through his skin. In summer, the heat vaporizes the mercury and ameliorates his condition.

Preventive Measures

In order to safeguard the health of the worker, it is necessary to consider, first, the worker himself, and second, his environment. A man who takes up the manufacture of thermometers should consult his physician, have a thorough examination, and from time to time have a re-examination made in order to detect any variation from normal health. From the description of the cases above, it will be seen that the habits, family histories and personal histories of the patients were investigated and complete physical and laboratory examinations made. Such examinations should be made from time to time and the housing hygiene and home environment noted. Then a complete survey of factory conditions should be made in order to discover the source of any poison.

Proper personal precautions in the factory require that the worker should prevent as far as possible any contact of the skin of his hands or body with mercury or other impurities. He should wear separate work clothes, which should be washed once weekly, and his street clothes should be protected from any contact with the poisons of the factory. He should thoroughly wash his hands and other exposed parts of the body with warm water and soap before eating, and should dry them with his own individual towel. No food should be eaten in the workshop. Lockers and individual towels and proper washing facilities, including running hot and cold water, brushes and soap, should be provided. The worker should guard against inhaling impure air in which may lurk dust, gases, and vapors

generated during the processes in the manufacture of thermometers. Proper provisions should be made for the control and removal of these impurities and for the reduction of the excessive heat, by means of hoods, exhausts, natural and mechanical ventilation. A supply of fresh, clean, cool air should be furnished. Faulty machinery, pipes, and sanitary equipment should be corrected. Especially is it necessary for the worker to be careful in the handling of glass and mercury, refraining from throwing either on the floors or benches, or from brushing off the mercury into the room. Enameled iron receptacles for catching mercury should be provided. Tops of benches or tables should be covered with enameled iron with raised borders, so as to prevent the mercury from falling to the floor. Wooden benches and floors are objectionable, as they favor the lodgement of spilled mercury in cracks and crevices. Flames should be placed under properly constructed hoods which will conduct vapors, gases, and heat to the outer air. These hoods should be entirely enclosed, having a sliding glass door in front, with openings for the insertion of the hands and arms of the worker. In this way workers will be completely protected during the process of filling bulbs with mercury.

Co-operation of employer and employees should be obtained to protect the health of workers in this industry, and it is gratifying to state that such co-operation is possible in most instances. Since mercurial poisoning is often slow in manifesting itself, it is frequently necessary to impress its dangers upon those who have apparently not yet been affected by the poison. Educational methods through health department officials, and, finally, enforcement of health codes may be necessary for refractory individuals.

THE HEALTH OF THE SCHOOL TEACHER*

An Analysis of a Series of Physical Examinations of a Group of Normal School Students

RALPH E. WAGER

Department of Biology, Northern Illinois State Normal School

THE attention now being paid to the necessity of arousing a national consciousness concerning matters of health has prompted this paper. Occupational diseases are being studied as never before. The results of the physical examinations of the draftees of the army revealed the fact that we are not, as a nation, physically fit. An aroused sense of the value and means of acquiring and preserving good health has grown out of it all, so that newspaper and magazine articles spread health knowledge broadcast. An inquiry concerning the health of the school teacher, therefore, seems timely.

But little is definitely known concerning the health of the school teacher as influenced by his vocational activities. Among the most recent contributions to the problem is a report made by a commission on the welfare of teachers of the New York State Teachers' Association — a report which summarizes the results obtained from a questionnaire asking information on the general problem and distributed among several hundred teachers of the state. In 1912 Terman published his booklet, *The Teacher's Health*, in which, in addition to his own contributions, he summarizes the results of studies made both in this country and abroad. But with these studies in hand one is unable to infer with assurance that much is known concerning the effects, *per se*, of the labors of the teacher upon his own health. So fundamental a professional activity deserves critical investigation with special reference to any direct occupational effects upon health. For the health of the teacher, even above that of members of almost any other profession, is an asset of more than personal value — it is a social asset of high order. For the teacher, health not only sets bounds for teaching activities, but is also a vital factor in influencing and determining mental attitudes and states, and, further, in radiating a subtle influence on pupils, as a result of which they, in turn, are moved to take on similar mental attitudes and states. A wholesome, healthful teacher is a powerful influence. Any insight, therefore, which may be obtained into the health status of this occupation is worth the effort.

A brief résumé of the salient points of the two studies referred to above will serve as a basis for the discussion to be presented. The report of the Commission on the Welfare of Teachers presents the results obtained from the extensive distribution of a detailed questionnaire, together with the testimony of a group of some ninety-five supervisors covering their observations on elements of health within the groups of teachers under their professional supervision. To the questionnaire, 2,076 replies were received, covering both elementary and high school groups, as well as urban and rural teachers, while the supervisors reported upon 3,730 cases of which 919 were urban and 1,157 rural. It is evident that the investigation covered a fairly cosmopolitan group and that the results, therefore, may be accepted as fairly typical, save that the larger cities were not represented. Furthermore, the replies represented a fairly large range of teaching years

* Received for publication March 29, 1920.

— 49 per cent., less than six years, to 12 per cent., twenty-one years or over.

From the 2,076 questionnaire cases it appears that:

1. Thirty-one per cent. were not sufficiently vigorous to meet successfully the continuous strain of teaching, while 10 per cent. reported chronic ill health.

2. Thirty and three-tenths per cent. reported health worse at the time of report than when teaching was begun.

3. Seventy-nine and seven-tenths per cent. reported health disorders within the previous five-year period.

4. Eighty-two and eight-tenths per cent. reported health disorders within the previous five-year period or at the time of report, and many testified that their health was as good as at the time of beginning teaching save that they were "more nervous."

5. Forty-one and one-tenth per cent. reported absence from school on account of ill health within the previous two-year period.

6. Sixteen and seven-tenths per cent. of women teachers reported partial impairment of efficiency due to the menstrual function.

In general the health of women was found to be poorer than that of men.

Equally striking were the reports of the supervisors. According to them:

1. More than one-third of their teachers belonged in one of four classes: (a) nervous, (b) irritable, (c) low in vitality or (d) affected with other handicaps. Sixteen and three-tenths per cent. were classed as nervous; 11.4 per cent. as irritable; 9.2 per cent. as low in vitality; 3.4 per cent. as affected with other handicaps. Assuming the same person not to be included in more than one group, this gives a total of 40.3 per cent. with a serious health impediment.

2. Seven and one-tenth per cent. had their efficiency impaired while under supervision.

As a general summary of the results of the investigation the statement is made that "about 30 per cent. of teachers are below the standard of physical health requisite for those entrusted with the instruction of children" while "36.6 per cent. of the group of teachers studied report nervous diseases during the two-year period 1913–1915." On this latter point, a table shows that the longer the term of service, the higher the percentage of those reporting nervous disorders. Of the total reporting, 45.9 per cent. attested to "nervous disorders" of some sort. It is obvious that nervous affections among teachers are of more than common occurrence.

Sixty-six and two-tenths per cent. reported conditions existing in their schools such as to contribute to the development of physical disorders. Of these conditions the following are the more common: excessive demands of school work, effects of poor supervision (unjust, unfair and destructive criticism), handicaps of children due to improper grading according to capacities, inadequate salaries, and inadequate teaching facilities.

Terman, in his discussion of the teacher's health calls attention chiefly: (1) to the physical equipment of those entering the profession, noting that some investigators maintain an adverse selective influence, at the very outset, favoring the entrance of those less able to measure up to the demands of other supposedly more arduous callings; and (2) to the adverse hygienic aspects of the teacher's work, including the conditions under which it is performed. He then summarizes the results of teacher-health surveys both in this country and abroad. From them two facts emerge: *viz.*, that respiratory tract and nervous afflictions obtain in an abnormally large number and percentage of teachers. As proof, he presents reports compiled from the U. S. Census showing that the death rate from tuberculosis among teachers exceeds by

about 5 per cent. that of the occupations of stonecutter and saloon-keeper, which are notoriously unhealthy and favorable to the development of tuberculosis. Likewise, deaths from tuberculosis among female teachers exceed by 19 per cent. deaths from it among females engaged in other occupations.

Terman also shows nervous disabilities to be especially rampant among teachers. The neurasthenic, with "drawn face and knitted brow," with a high-pitched voice, irritable, unstable, troubled with nervous headaches and fixed ideas, is a characterization all too applicable to an abnormally large number of teachers. Probably 20 per cent. is a conservative estimate of the percentage so afflicted, and in this connection Terman makes several relevant observations. According to popular belief the labors of the teacher are constricted between the hours of 9 o'clock in the morning and 4 o'clock in the afternoon, with recesses and a long noon hour to lessen still further the working period. It is popularly believed to be an easy sort of job. In reality, the hours are much extended by out-of-school preparation, extra school-time assistance to backward children, and by extensive social duties in connection with school work. More to the point, according to his contention, is the fact that one hour of room teaching, with its constantly shifting attention is undoubtedly as fatiguing as two hours of work in which constant attention-shifts are not demanded. Overwork in a situation demanding a constant drain upon nervous resources is, undoubtedly, one of the chief elements contributing to the frequent occurrence among teachers of nervous afflictions. The public needs to be educated to these facts before necessary reforms can be effected.

Terman's reviews of studies made abroad are, in the main, corroboratory of those made in this country. It is impossible here, however, to do more than refer to them. As a general conclusion, it appears that teachers in abnormal percentages suffer from respiratory tract and nervous diseases.

The evidence for the belief in a high morbidity rate for teachers seems valid. Explanations for this condition are usually found in two large or general factors: (1) the unhygienic conditions under which the work is done, including the abnormal nervous stresses attendant upon it, and (2) the possible existence of a selection of those types especially disposed toward certain physical and mental lesions.

Attempts to evaluate the influences of teaching, *per se*, have been difficult and inconclusive because of a lack of data concerning the physical equipment of teachers on entering the profession. Teacher-health surveys have been made after the profession has been followed for some time. In order to determine what are the effects of the professional activities upon health it is necessary to have a body of data covering the physical status of a representative body of teachers when they enter the work. This may then be compared with data collected subsequently. It is the purpose of this paper to present (1) the results of a series of physical examinations of a number of normal school students, prospective teachers all, as a typical picture of a group about to enter their professional activities, and (2) to present certain obvious conclusions growing out of the facts thus derived. Elsewhere will be presented the discussion concerning the existence of a selective influence which some writers assert to exist and to be responsible for the presence in the ranks of teachers of abnormal numbers of mentally and physically morbid types. It is my purpose simply to state the conditions as found and to make certain recommendations which seem reasonable in connection with them. It is hoped that an awakened interest in the hygiene of the profession may speedily lead to more extensive and intensive studies of a similar sort, and that

theory and opinion may be replaced by quantitatively determined facts.

Observations made in daily contact with a body of normal school students convinced the writer of a need for at least a cursory physical examination to discover defects of a nature so serious as to interfere with the performance of their school work. In the absence of any previous efforts on the part of the institution to meet this need, and with no funds with which to work, the inertia to be overcome was tremendous. Consent to make the trial, however, was finally secured, and the cooperation of a number of local physicians and dentists was otained, these professional men agreeing to give two hours each day on three days in the week. By alternating, it thus became possible to have medical assistance daily. A trained nurse was furnished by the institution. Students were divided into groups and the task begun.

It seems almost incredible that a group of students, all high school graduates, should so thoroughly misinterpret a plan obviously concerned with their own welfare, yet it is true that at the start a very energetic opposition developed, aided and abetted by some who were certain that physical and moral destruction loomed ahead. The idea of the body as a precious possession, which should be cared for and understood like any other thing of great value, seemed to be entirely absent. Apparently the instruction in the high school and grammar grades had made but little impression of the wholesome and vigorous sort. As the movement gained momentum, however, attitudes changed, and finally a hearty co-operation was secured. In the end it was felt that a real contribution to the lives of these students had been made.

The examinations were not as thorough as it is desirable such examinations should be, yet they served to uncover serious defects. It was found that a team of five workers (a nurse, a dentist, two physicians and the writer) could examine from fourteen to sixteen people in the course of a morning. The nurse and the writer began at 9 o'clock, attending to preliminary points, and thus had the examinees ready for the dentist and physicians who came at 10 o'clock, and finished at 12 o'clock.

The record sheet reproduced below indicates the nature of the examination. All details were entered upon it previous to the physical examination so that when the examinee passed to the physician a preliminary body of facts was ready to expedite his work. He then made his examination, and, if such proved advisable, entered upon the sheet his recommendations. These recommendations served as sources of advice in the follow-up of the cases, and in many instances they proved of very great value.

During the fall of 1916, 320 females and 42 males were thus examined; in 1917, 257 females were studied. The tabulated findings of these two series are presented in Tables 1 and 2. It should be pointed out that the earlier series is by far the less reliable. This is true because the initial results sought for were less clearly defined than they were later. The experiences gained the first year taught many things concerning possibilities and desirable outcomes. As a result, we feel that the later series presents a fairly reliable picture of the physical condition of these prospective teachers. Then, too, in the earlier efforts the services of a dentist were not available. The examinations of the teeth were made by a physician, whose eyes were naturally not skilled to find small defects. As a result only marked cases of dental defects were noted.

Certain facts stand out with especial clearness in these tables. In the first place, a large percentage of females suffer as the result of irregularities in the menstrual function. This is especially noticeable in the later series which shows 26 per cent. so affected. The discrepancy between the two

series is due to the greater care exercised in the determination of the data in the later series. This accounts also for similar discrepancies in other parts of the tables. I have explained above that it was the purpose at the outset to uncover only the conspicuous defects. Later, however, it was found that a more thorough examination might yield useful data for comparative purposes and greater care was thereafter exercised.

Noteworthy also, in the second place, is the frequency of derangements of the digestive tract. This takes the form of constipation. Undoubtedly this is due to improper habits as regards exercise, but more especially to wrong dieting. Thirty per cent. of the men examined were suffering from digestive derangements, and 32 per cent. of the women in the later series.

A third fact of note concerns the infections of the tonsils. And here again a discrepancy between the two series is easily explained on the basis which has already been indicated. An infection rate of 25 to 44 per cent., however, is indicative of a large amount of future trouble. Derangements of the respiratory tract are few — an average of 1.7 per cent. This does not corroborate Terman's contention that respiratory tract diseases are of all others most likely to be found in teachers. But, if the present data are reliable, and if it were to be found that respiratory tract diseases do exist in unusual numbers among actual teaching individuals, then the conclusion might well be reached that the increase is due primarily to factors in the environment of the school. There are evidences that this is true. Dublin, for example, shows that influenza exhibits a higher incidence among teachers than among other occupational groups of a similar sort. His data on the whole are not

NAME .... DATE OF EXAMINATION .... PHYSICIAN ....

Nationality	Date of Birth	FINDINGS OF PHYSICIAN	HISTORY
Std. Height (1)	Weight	Teeth	.... age ....
Sit. Height (2)	Breath Cap.	....	.... age ....
Wt.-Height Coef.	Vital-Height Coef.	Glands-Cervical	.... age ....
Temperature	Pulse	Tonsils	.... age ....
Hemoglobin	B. P.	Spine	.... age ....
Vaccination Date	Pos. .... Neg.	Stomach & Digestion	.... age ....
Eyes		....	.... age ....
....		Heart	Effects ....
Hearing		Lungs	....
....		....	....
Extremities		Kidneys	....
....		Urine-Chem.	Type ....
Posture		Microscopical	....
....		Periodicity	Grip, R .... L ....
....		General	Tapping, R .... L ....
Skin and Hair		....	Form Board ....
....		....	....

TABLE 1. — RESULTS OF PHYSICAL EXAMINATIONS OF NORMAL SCHOOL STUDENTS, 1916 SERIES

320 Females

Irregular Periods	Digestive Tract	Spine	Glands	Respiratory Tract	Teeth	Heart	Urinary Tract	Eyes	Ears	Extremities
52	constipation, 34 chr. appendicitis, 6 gastritis, 1	scoliosis, 21 weak back, 2	bad tonsils, 79 with adenoids, 2	bronchitis, 2 chronic catarrh, 3 tuberculous, 1	very bad and probable cause of disease, 17 with pyorrhea, 2	13	involving bladder, 7	needing glasses to be fitted, 57	hearing affected, 17	flatfoot, 78
16%	13%	7%	25%	1.8%	6%	4%	2%	17.7%	5.5%	24%

42 Males

Irregular Periods	Digestive Tract	Spine	Glands	Respiratory Tract	Teeth	Heart	Urinary Tract	Eyes	Ears	Extremities
	constipation, 7 indigestion, 3 gastritis, 2 chr. appendicitis, 1	scoliosis, 1	diseased tonsils, 10 with adenoids, 1		(not examined)	1		needing glasses, 7		flatfoot, 2
	30%	2%	26%			2%		16%		4.7%

TABLE 2. — RESULTS OF PHYSICAL EXAMINATIONS OF NORMAL SCHOOL STUDENTS, 1917 SERIES

257 Females

Irregular Periods	Digestive Tract	Spine	Glands	Respiratory Tract	Teeth	Heart	Urinary Tract	Eyes	Ears	Extremities
68	constipation, 50 indigestion, 16 chr. appendicitis, 2 constipation and chr. appendicitis, 5	scoliosis, 22 congenital scoliosis, 1 weak, 1	enlarged cervicals, 19 enlarged thyroid, 33 badly diseased tonsils, 57 enlarged tonsils, 34 adenoids, 3	bronchitis, 2 spitting blood, 1 probably tuberculous, 2	requiring dental care, 87 pyorrhea, 16	endocarditis, 5	bladder, 5 urine examination advised, 17	compound myopic astig., 30 compound hyperopic astig., 1 myopia, 12 eye strain, 16 refit needed, 12 color blind, 1	one or both ears affected, 21	flatfoot, 97
26%	28%	9.5%	44% *	1.9%	40%	1.9%	8.5%	28%	8%	38%

* Double infections reckoned as one.

comparable with ours since they are compiled only from reported cases of disease so serious as to compel absence from school. In general, however, they corroborate our findings.

Only three cases of tuberculosis of the lungs were found, and one of these was doubtful. This would give but 0.5 per cent., which is surprisingly low considering the fact that the great bulk of these subjects were between the ages of 18 and 21 years, ages at which the expectancy for the disease is very much greater. If, then, the rate of tuberculosis is very much greater among active teachers, there must be factors in the teaching environment to bring about such an increase. If, however, the per cent. of tonsillar infections were added to that of genuine respiratory tract diseases, as is sometimes done, there might then appear to be a remarkable instance of an unusually high degree of infection. Obviously such procedure is unwarranted. It is evident that the teacher enters the school with a very small likelihood of carrying tuberculosis or other respiratory tract derangements with her. The untoward conditions under which her work is done may well account for subsequent high morbidity due to such afflictions.

In our later series, 38 per cent. were found to be in need of more or less immediate dental treatment. By this is meant that conditions existed which were thought to be serious enough to influence health. These conditions ranged from an extensive array of badly decayed teeth to aggravated cases of pyorrhea. In not a few instances dental attention had been impossible on account of financial inability to provide for it. In a few instances it was a matter of carelessness.

Diseases of the heart and urinary tract were few. Several cases of endocarditis were found, only two of which were of a serious nature. These seemed to be the result of aggravated tonsillar infections. The urinary tract presented few instances of disease, what trouble there was consisting chiefly of frequent urination. Several urine tests were made for sugar and albumin but with negative results. It must be admitted, however, that information on these points was not as easily obtained, under the circumstances, as on the others. It is likely that the data are distorted in this respect.

A surprisingly large number of cases of eye defects were discovered. In many cases these defects were so extreme as to interfere very greatly with school work. These pupils were, nevertheless, attempting to do their daily tasks with these handicaps. Headaches and nervousness were not associated with possible eye defects. Here again, remedial measures were sometimes not taken on account of a lack of the necessary funds. Obviously some provision should be made for meeting the needs of such cases.

Noteworthy also is the very large percentage of cases of flatfoot. Observations were made on this point not only for the purpose of determining the number so afflicted, but also in order to advise against the use of fashionable high-heeled shoes. It is not a certainty that all such defects are due to high heels but undoubtedly many are. The stout, large boned, and short-digited type of person appears to be naturally flatfooted. The same appears to be true also of the opposite extreme, represented by the very long and narrow foot in which the arch is likely to be low. Of the well-developed foot, strongly arched, and fully able to bear the body weight, one finds but few cases — among the females at any rate. The most discouraging part of the situation lay in the fact that these young women cared less about their feet than they did about being in style. This is an unfortunate commentary upon the mental set as well as upon the influence of previous years of school and home life in

determining ideals of health and physical perfection!

Such, then, were the conditions found. Obviously the presence of physical defects — for the most part remediable — in such large numbers, is very strongly suggestive that not all of the disorders of teachers are the results of unhygienic environmental factors, save in so far as such factors serve to bring pre-existing defects into prominence. Many such conditions as are shown to exist eventuate in lesions of a far more serious sort. For example, constipation, defective vision and irregular periods are a fitting prelude for later nervousness, which — possibly under the stresses of the schoolroom — may develop into aggravated forms of mental trouble. It is not our contention that teaching offers no factors or conditions which are sufficient to develop lesions of a serious sort, but rather to call attention to the fact that not all serious disorders can be attributed to such factors. Not a few of the conditions which have been described above are remediable, were there only some agency capable of uncovering the defects and then of seeing to it that suitable prophylactic measures are employed. This might well be undertaken by the state inasmuch as the quality and even the quantity of service later received from the teacher by the state is determined, in part at least, by the teacher's physical excellence. No better investment for the general public good could be made.

It is impossible to infer from our observations whether there is a selective activity drawing into teaching types physically below the general health level. Our data serve only as indicative of the equipment of a typical group of potential teachers. Subsequent investigation, however, may throw further light on the matter. Making such comparisons as are possible for us to make, we feel that there is no evidence that persons below par physically are drawn especially into teaching.

Our data in general suggest an imperative need for a thorough physical examination of those contemplating entering the teaching profession. This need exists not only for the sake of the candidates themselves — great as their need is — but also on account of the relation which is to exist later between these teachers and their pupils. Such examinations are advisable also as a wise provision for later effective service. It is the belief of the writer that candidates possessed of low physical health should be debarred from entering the classroom as teachers. He recognizes the difficulties of setting a standard and obtaining a just and fair adherence to it, but this difficulty does not detract at all from the fact that such a standard is desirable. He is of the belief also that a vigorous and well-developed plan should be perfected to develop in the minds of teachers the value of a good body and the means of attaining it. This cannot be done by the mere reading of books; it must be associated with some general movement which finds its significance in the great needs of human life. Health must be recognized as a part of the necessary equipment of a worthy and effective life spent in the training of youth.

The facts presented in this paper seem to warrant the following recommendations:

1. That thorough physical examinations, at state expense, be given candidates for teaching; that these be followed by suitable measures to remedy defects wherever possible; and that similar examinations be given at stated periods thereafter in order to discover initial lesions.

2. That conditions in the schools which may lead to physical or mental disorders be definitely determined and, in so far as possible, corrected. The immediate problem concerns itself not merely with the question as to how great is the extent of physical and mental maladjustment, but also with the fact that at present the physical and mental equipment of a large percentage of

teachers is not *sufficient*. Efficiency demands the reduction of the adverse conditions to an absolute minimum.

3. A standard of physical excellence is desirable for those entering teaching. The setting of such a standard must be left to future studies.

General Summary

1. Our data yield no evidence that there is a selective activity drawing into the profession teaching types predisposed to either physical or mental weaknesses. Discussion concerning this phase of the problem will be published elsewhere.

2. On the other hand, prospective teachers as represented by normal school students display physical defects — for the most part, remediable — which may readily lead to the types of health disabilities found among teachers. For example, irregular periods, constipation, tonsillar infections, eye strain, and other defects, would seem to account for later nervousness which, under the stress of teaching, may possibly eventuate in neurasthenia and nervous exhaustion.

3. Suitable data are not now available to determine possible morbid influences of teaching. Our data are presented as a typical picture of a group of entrants upon the work of the profession. Later studies should reveal the true effects of teaching itself, including, of course, the effects of the environmental factors, both physical and psychical.

BIBLIOGRAPHY

Dublin, L. I.: Physical Disability of New York City School Teachers. School and Society, Oct. 7, and 14, 1916.

Terman, L.: The Teacher's Health. Boston, Houghton Mifflin Company, 1913.

Wood, T. D.: Report of Commission on Welfare of Teachers, New York State Teachers' Association, 1916.

NOTICES

AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS

(*Meeting to be held in conjunction with the Health Service Section of the National Safety Council in Milwaukee, Tuesday and Wednesday, September 28 and 29, 1920.*)

PROGRAM

September 28, 1920 — Tuesday A.M.

Dr W. Irving Clark, Jr., *Chairman*

Dr. C. C. Burlingame — "Doctor and Patient *vs.* Employer and Employee."

Dr. Harry E. Mock — "Preventive Medicine in Industry."

Dr. Carey P. McCord, *Chairman* — "Committee Report on Occupational Diseases."

Dr. D. B. Lowe — "The Mortality and Morbidity of the Factory Worker."

September 29, 1920 — Wednesday A. M.

Dr. Otto P. Geier, *Chairman*

Chairman's Address — "The Future of Industrial Medicine and Surgery."

Dr. John J. Moorehead — "Fractures Incident to Occupation."

Dr. Wm. O'Neill Sherman — "Industrial Surgery."

September 29, 1920 — Wednesday P. M.

Dr. W. Irving Clark, Jr., *Chairman*

Dr. A. W. Colcord — "Physical Examination of Employees."

Dr. W. A. Sawyer — Subject not reported.

Dr. H. M. Brewer — "The Dental Dispensary — Its Importance, Its Help and Its Cost."

INSTITUTE OF INDUSTRIAL NURSING

An Institute of Industrial Nursing under the auspices of the New Haven Visiting Nurse Association will be held September 20 to 30, inclusive, at 35 Elm Street, New Haven, Conn.

An intensive and interesting program has been prepared and the following experts in Public Health will give lectures:

C.-E. A. Winslow — Industrial Hygiene.
Florence Swift Wright — Industrial Nursing.
C. C. Burlingame — Hospital Management and Record Keeping.
George Blumer — Industrial Diseases.
R. M. Thompson — Industrial Relations.
Mary P. Wheeler — Social Problems.
H. C. Link — Industrial Psychology.
Maria Nelson — Nutrition and Budgets.

Only graduate registered nurses interested in industrial work are eligible — preferably nurses with public health experience.

The fee is $5.00, payable at time of registration, which must be not later than September 12.

INDUSTRIAL CLINIC

The Health Department of Norton Company, New Bond Street, Worcester, Mass., holds a monthly industrial clinic, at which cases of industrial accident and disease are presented and discussed. Three clinics have already been held, the first upon "Infectious Arthritis in Industry," the second upon "Fractures in Industry," and the third upon "Cardiac Disease in Industry."

The clinics last from 5 until 6 o'clock in the afternoon. Any industrial or other physicians and surgeons interested are cordially invited to attend. If those interested will write, their names will be placed on the mailing list and they will receive notification of the exact date and time of each clinic.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | OCTOBER, 1920 | NUMBER 6

FATIGUE AND EFFICIENCY OF SMOKERS IN A STRENUOUS MENTAL OCCUPATION *

J. P. BAUMBERGER AND E. G. MARTIN

(From the Laboratory of Physiology, Stanford University)

INTRODUCTION

THIS paper is the first of a series reporting an investigation of the industrial efficiency of persons using tobacco in different amounts. Many studies have been made of the effects of tobacco on the human body, but as far as we know no industrial output study of smokers and non-smokers has been reported hitherto. The previous investigations have dealt with such subjects as the increase in blood pressure accompanying smoking (Lee, 1); the higher percentage of smokers among pulmonary tuberculosis cases, and their lower susceptibility to treatment (Flick, 2); retardation of growth due to smoking in youth (Seaver, 3); the showing by Clark (4) and Meylan(5) that the scholarship standing of smokers is considerably inferior to that of non-smokers; and finally the finding of Lombard (6) from experiments on himself that smoking decreases muscular strength. On the other hand, as Meylan (5) points out, the lower scholarship standing of smokers may be due to their greater devotion to athletic, fraternity, and social life in general. The sociable "good fellow" type usually takes up the habit of smoking. Therefore, a classification on the basis of smoking habit may have the objection that the resulting grouping is really of the sociable as contrasted with the more studious and purposeful type of mind. Much of our present knowledge of the effects of tobacco is subject to this same line of criticism. For example: Is a person more susceptible to tuberculosis because of smoking, or is one, who by physical weakness or malnutrition is predisposed to tuberculosis, more likely to become a smoker? It is difficult to select any group for study to which criticism of this sort might not be applied, but to our minds an industrial group is likely to be as free from it as any that could be selected.

OBJECT

Our plan includes the study of the effects of tobacco both on hand workers and on brain workers. In selecting particular occupations for investigation we would naturally prefer strenuous to easy, on the theory that the harder the subjects of our study are working the more pronounced are the effects of tobacco likely to be, if any such effects exist. For the purposes of an objective study of industrial efficiency it is

* Received for publication June 5, 1920.

necessary that some quantitative criterion thereof be available. Current practice in industrial hygiene approves output as an acceptable criterion (Florence, 7). Obviously not many strenuous mental occupations lend themselves to output studies; the labor of professional men or of business executives cannot be described in terms of stated output. Only a task that is of a repetitive character serves our purpose. Furthermore, for the comparison that we wish to make it is necessary that a considerable number of individuals doing similar work be available for study. Most large offices have much routine work, but under modern conditions of office organization such work is ordinarily so simplified and systematized as scarcely to measure up to the desired level of strenuousness. Moreover, routine office tasks are now commonly assigned to women, who seem peculiarly fitted for the efficient handling of routine, while any study of the effects of tobacco in industry must be made on men.

We finally hit upon the occupation of telegraphy as meeting most nearly our needs, since the sending and receiving of messages by Morse code involves a high degree of attention, of neuromuscular coordination in the manipulation of the key and typewriter, of memory in the transposition of dots and dashes into letters, or the reverse, and of association in the connection of letters into words and sentences. This is the most strenuous mental operation of a routine nature that we have had occasion to observe. Through the courtesy of the wire chief and the chief clerk in a large city telegraph office we were enabled to carry on the investigation here reported. We take this occasion to acknowledge with appreciation the helpful consideration shown us by these officials.

Process

At the telegraph office we were given permission to make an hourly output study of sixteen operators, fourteen men and two women, constituting a group under a single supervisor. Two of the men were, for extraneous reasons, inadequately studied. Records were obtained only for three days, but both the wire chief and the chief clerk considered our curves strictly typical of output for the occupation of telegraphy. Moreover, we were informed that it is the regular practice of the company to base determinations of output for calculating necessary enlargements, often involving large expenditures, on the records of a single day. The operators were all highly experienced and efficient, as would be anticipated from their employment in a large city office. All but two had had ten years or more of experience as operators. One of the women had been an operator for only five years, and one of the men, a light smoker, had been at this work for only three years.

The work was carried on under high tension in a very busy and noisy room. The actual operations may be described briefly as follows:

Sending. — Remove typewritten message from file; send by Morse code with telegraph key; mark off words with pencil as sent; place completed message on file.

Receiving. — Receive Morse code message from receiver; typewrite words received; place completed message on file; place blank sheet in typewriter.

The operators studied were working an eight and one-half hour shift, from 8 in the morning to 4.30 in the afternoon, with half an hour for lunch at some interval between 11 and 2 o'clock, and an additional rest period, known as the "short relief," taken at some convenient time during the day. Thus, although the length of the shift was eight and a half hours, the actual working time was but seven and a half. Since these recess periods came at irregular intervals it was necessary to treat them in the same category as lost time from wire trouble or

slack business, correcting the records to an hour basis according to the method outlined below. A similar procedure was adopted for the last half hour of the shift, making the record as a whole correspond, therefore, to a nine-hour day.

Collection of Data

The hourly output records were collected at the end of each hour from the tally sheets which each man had on his desk. These tally sheets consist of a series of numbers from 1 to 500, one of which is checked off for each message sent or received. With the aid of the supervisor, account was taken of all time lost in wire trouble or slack business, and suitable credit was given for shorter sets of messages ("books") or for long "day messages." Other telegrams would average close to the customary ten words. It was not possible to keep the two processes, sending and receiving, separate, but as either involves its converse at the other end of the wire, the two processes can be considered as entirely comparable.

The allowance for lost time was calculated as follows: The actual number of messages handled by one operator during one hour was known, as was the number of minutes lost during that same hour by that operator; the number that would have been handled had the operator worked throughout the hour at the same rate was determined from the formula, $A_a : R :: A_t : 60$, where A_a is the actual number of messages handled, A_t the actual operating time in minutes, and R the desired number per hour.

To obviate errors due to differences in individual speed or skill the hourly outputs were recalculated on a percentage basis. The method was to compare the average output of each operator for each of the nine hours of the day with the grand arithmetic mean of all the hourly records of that same operator. Calling the latter figure 100, by a simple proportion the figures for the individual hours were reduced to percentages of the grand average. The percentage output for each hour for the whole group of operators was obtained by averaging the percentage hourly records of all the individuals for each hour.

Fatigue

From observation the operators seemed to be quite "fagged" by 2 o'clock in the

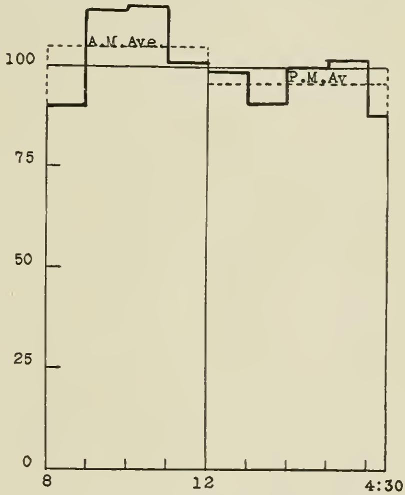

Fig. 1. — Percentage output of all operators. In all the figures the heavy upper line indicates hourly output and the straight light line, the daily average.

afternoon, and their hourly output records showed a marked decline at that time. A decrease in hourly output has usually been considered to be a definite indication of fatigue, and notwithstanding some criticism (Spaeth, 8), most current studies of industrial fatigue are employing output as a criterion. Whether the fatigue is muscular or central is, of course, not determined by this index (Bainbridge, 9).

That marked fatigue develops toward the end of the shift in Morse telegraph operation is indicated by the curves of aver-

age hourly output, shown on a percentage basis in Figure 1. This figure shows the usual speeding up early in the shift, from a percentage output of 90 in the first hour to 115 in the third; this is followed by a gradual decrease to 91 in the sixth; a recovery, amounting to 102, in the eighth; and a final decline to 88 at the end. The average for the first four hours is 105, as contrasted with an average of 96 for the

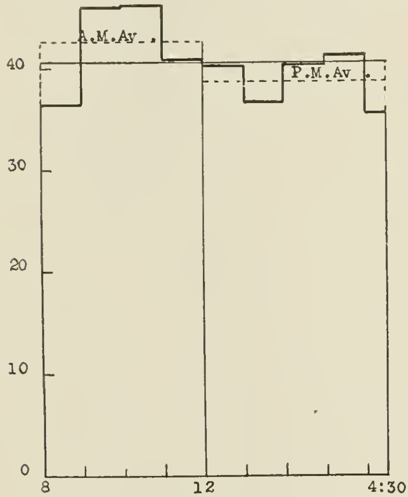

FIG. 2. — Actual output rate of all operators.

last five. These characteristics are fairly typical of the usual curve of fatigue, namely, the speeding up in the first hours of the morning, followed by a decline; a similar but lower peak in the afternoon period; and a large drop at the end of the day.

The curve of actual messages handled, corrected to an hourly basis, follows necessarily the same general course for successive hours of the day as does the percentage curve. Since the actual figures are of interest the curve showing them is given in Figure 2. As the figure shows, the rate increases from 36.5 messages an hour in the first hour to 46.25 in the third, then falls to 36.75 in the sixth, rises to 41.3 in the eighth, and falls at the end of the day to 35.5. The average message rate is 42.6 an hour during the first four hours, as contrasted with 38.8 in the last five hours of the day, the average for the whole day being 40.6.

Efficiency of Smokers

The habits of the individual operators, as regards use of tobacco, were obtained from the supervisor, who had known the operators for a long period of years, and who questioned them when in doubt. All the men of the group under investigation smoked more or less; the two women were non-smokers, but could obviously not be used as such for comparison with male smokers, as a basis for conclusions as to the effects of smoking on efficiency. The records of the women operators are included, however, as a matter of interest. Our study necessarily reduces itself to a comparison of light and heavy smokers so far as this particular group of workers is concerned. The men who smoked cigarettes, pipes, or cigars well-nigh incessantly while off duty were classed as heavy smokers — there were 7 men in this group; those who smoked two or three cigarettes before work, at noon, and after work, or who smoked about two pipes or one cigar a day were classified as light smokers — this group included 5 men. As stated above, the other two men did not yield sufficient data to justify their inclusion in this section of the investigation. The operators were not allowed to smoke while at work.

A comparison of the three groups, women, light smokers, and heavy smokers, with respect to output brings out some interesting facts. The comparison is of hourly rate, hour by hour, and is given in detail in Table 1. In the same table are set down the statistical bases for judging the reliability of the stated averages, namely,

the standard deviation, the probable error of the mean, and the Pearson coefficient of variability. The figures show that the average hourly output rate of the women exceeded that of the men in every hour except the fifth. Since the group of women was so small, numbering only two, this result probably indicates superior individual skill, rather than any general difference due to sex. The heavy smokers start out at a higher rate than the light smokers in the first hour (37.8 ± 0.91 as against 28.5 ± 1.62), but fall below the light smokers in all the following hours except the seventh. In the last hour the rate of the heavy smokers is 29.8 ± 1.6 as compared with 37.5 ± 2.74 for the light smokers. The average rate for the day for the heavy smokers is 38 as against 40.1 for the light smokers and 46.6 for the women. Applying the accepted criterion of reliability, namely, the probable error of the mean, with the proviso that differences between means to be significant must contain the probable error twice and should contain it three times, the following conclusions are found to be statistically dependable (see Table 2): The heavy smokers start their work at a much higher rate than the light smokers; they fall below the light smokers during most of

TABLE 1. — COMPARISON OF HOURLY RATES OF HANDLING MORSE MESSAGES, VARIOUS GROUPS. STATISTICAL VALIDATION OF THE AVERAGES PRESENTED

Hour	1	2	3	4	5	6	7	8	9
All Operators									
Rate	*36.48*	*46.1*	*46.24*	*40.78*	*40.24*	*36.76*	*40.36*	*41.35*	*35.5*
Standard deviation	6.48	7.8	8.22	7.08	8.13	7.8	9.06	8.82	9.9
Probable error of mean	0.95	1.07	1.0	1.03	1.12	1.07	1.32	1.31	1.48
Coefficient of variability	17.7	16.9	17.8	17.4	20.2	21.2	22.4	21.4	27.8
Heavy Smokers									
Rate	*37.8*	*45.02*	*42.25*	*38.77*	*38.98*	*31.64*	*39.1*	*38.5*	*29.8*
Standard deviation	5.04	8.58	7.44	5.79	5.76	5.82	9.08	8.7	7.5
Probable error of mean	0.91	1.66	1.25	1.14	1.14	1.08	1.5	1.95	1.6
Coefficient of variability	13.3	19.0	17.6	14.9	14.8	18.4	18.1	22.6	25.2
Light Smokers									
Rate	*28.48*	*48.21*	*43.3*	*43.0*	*44.75*	*40.0*	*33.92*	*41.5*	*37.5*
Standard deviation	4.2	9.3	8.97	7.68	11.04	9.3	9.0	9.06	10.8
Probable error of mean	1 62	2.36	2.02	1.57	2.12	2.2	2.3	2.5	2.74
Coefficient of variability	14.7	19.2	20.7	17.8	24.7	21.2	26.4	21.8	28.8
Women									
Rate	*40.9*	*48.3*	*56.3*	*44.0*	*37.0*	*43.52*	*54.25*	*49.5*	*45.5*
Standard deviation	1.47	3.06	4.05	6.18	3.36	7.5	3.24	5.19	8.4
Probable error of mean	2.24	0.92	1.21	2.08	1.13	2.9	1.09	1.75	3.26
Coefficient of variability	18.3	6.3	7.2	14.0	9.08	17.2	5.9	10.5	18.5

the hours of the day; and they are working at a much slower rate than the light smokers at the end of the day.

In addition to these conclusions, based wholly on output rate, the occupation of telegraphy offers another means of judging the efficiency of groups of operators, through study of their reaction to changes in the volume of business, known technically as the circuit load. In the organization of the city telegraph office groups of operators are assigned to various wires in accordance with the number of messages coming in or to be sent out over them. As the volume declines on a particular wire one or more of the operators working on it will be withdrawn, to be assigned to another busier wire, or perhaps to go on "short relief." On the other hand, as soon as a particular wire is found to be offering a greater volume of business than the operators on duty can care for, one or more additional men are assigned to it. The circuit load is calculated by dividing the number of messages actually handled over a particular wire by the number of operators on it, so that it is a measure of the actual average output of the group of operators on the wire in question. In calculating circuit load no account is taken of the way in which the work is distributed among the different operators; while in theory each should bear his exact proportion, in practice there are wide differences in the amount handled by various workers. The operators in our experiments were shifted about from wire to wire as need arose, so that in the course of the study they formed parts of many circuit-load groups. In every such group by comparing the average number of messages per man for the group, which, as stated above, is the circuit load, with the actual number for a particular operator one can determine whether or not the individual was bearing his fair share of the load. In Figures 3 and 4 this comparison is shown graphically for the heavy and light smokers, together with the facts as to output rate presented in Table 1. The figures show that the average circuit load increases toward evening, while the average rate declines. This means that there is very much less free time in the afternoon than in the morning While the operators are fresh they maintain a high rate, and keep far enough ahead of the business so that they gain considerable free time; in the afternoon, on the other hand, the combination of increasing business with slowing rate keeps the operators very fully occupied, depriving them of free time. It is clear that the operators who maintain the highest afternoon rate will handle more than their share of messages during that time.

TABLE 2.—DIFFERENCES BETWEEN LIGHT AND HEAVY SMOKERS, HOUR BY HOUR, WITH RATIO OF DIFFERENCE TO PROBABLE ERROR FOR EACH HOUR

Hour	Rate for Heavy Smokers	Rate for Light Smokers	Difference	Ratio of Difference to Average Probable Error
1	37.8 ± 0.91	28.48 ± 1.62	−9.32	−7.3
2	45.02 ± 1.66	48.21 ± 2.36	+3.19	1.5
3	42.25 ± 1.25	43.30 ± 2.02	+1.05	0.6
4	38.77 ± 1.14	43.00 ± 1.57	+4.33	3.1
5	38.98 ± 1.14	44.75 ± 2.12	+5.77	3.5
6	31.64 ± 1.08	40.00 ± 2.2	+8.36	5.0
7	39.10 ± 1.5	33.92 ± 2.3	−5.18	−2.7
8	38.50 ± 1.95	41.50 ± 2.5	+3.00	1.3
9	29.80 ± 1.6	37.50 ± 2.74	+7.70	3.5

The application of these considerations to our two groups of light and heavy smokers brings out some interesting facts. As Figure 3 shows, the heavy smokers handled more than their share of messages in only two hours, the second and fifth; in the first hour they handled just their share; and in the other six hours less than their share. From the sixth to the ninth hour the average circuit load affecting these operators gradually increased from 27 messages to

34; during the same period the average actual number handled by the heavy smokers fell from 25.5 to 24. The light smokers, on the other hand, bore more than their share of the load during the afternoon when the business was heaviest. The average circuit load affecting this group rose between the fifth and eighth hours from 22 to 37. In the same time the average actual number of messages handled rose from 21.5 to 39. In the ninth hour the average circuit load fell to 35, but the average number of messages handled by the light smokers fell only to 38. During the morning hours the light smokers bore almost exactly their share of the circuit load except in the first and second, when they fell far short of doing so. It happened that during the period covered by our study the light smokers were working for the first two hours of each day in groups which included two extraordinarily rapid women operators, who carried during these hours much more than their share of the circuit load, so that the men who were working with them made a correspondingly poor showing. The heavy smokers did not happen to be assigned in groups with these women at any time while our investigation was in progress.

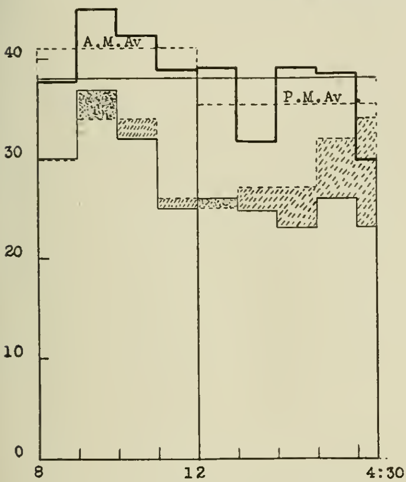

Fig. 3. — Actual output rate of heavy smokers. (See legend of Figure 1.) The irregular light line shows the number of messages handled in each hour. The irregular broken line shows hourly circuit load. Cross hatching shows number of messages handled below the circuit load. Stippling shows number of messages handled in excess of the circuit load.

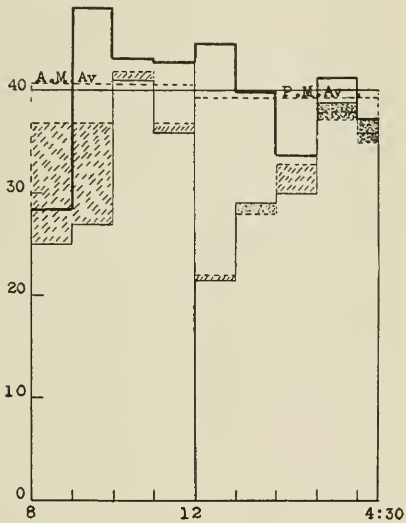

Fig. 4. — Actual output rate of light smokers. (See description of Figure 3.)

On the whole these figures establish a definitely better reaction to increase in circuit load on the part of light smokers than on the part of heavy smokers.

Discussion

If the data on which we base our conclusions are representative, they establish two respects in which heavy smokers fail to maintain the level set by light smokers in a strenuous mental industrial occupation, namely, in a lessened ability to sustain output to the end of the working day, and in a diminished power to react by increased effort to an increase in the volume of business. They indicate, also, in favor of heavy

smokers, a better output during the first hours, although this does not amount nearly to enough to compensate for the lowering of efficiency toward the close of the day. On the whole, they constitute an argument in favor of moderation in the use of tobacco on the part of industrial workers whose tasks fall in the category here under discussion. Although we would hesitate to urge this conclusion on the exclusive basis of the somewhat meager data presented in this paper, it is in line with the findings of the various investigators of the records of college students referred to in the introductory section (4, 5), and also of Pack (10) in his studies of football players. All these workers agree that extensive use of tobacco goes hand in hand with relatively low scholarship. It is probable, moreover, that no class of men is oftener advised by physicians to use moderation in consumption of tobacco than that made up of business executives, men who habitually do mental work under tension. All these facts are in line with the conclusion suggested by our observations that strenuous mental work is likely to be affected adversely by heavy smoking.

Summary

1. The output curves of a small group of Morse code telegraph operators show in general the course typical of fatigue in occupations involving attention and neuromuscular co-ordination (Lee, 11).

2. The heavy smokers of the group show a higher output rate at the beginning of the day than the light smokers, but their rate falls off more markedly in the later hours, and their production for the whole day is definitely less than that of the light smokers.

3. The heavy smokers show also less ability than the light smokers to respond to increasing pressure of work in the late hours of the day by handling their full share of the work presented.

BIBLIOGRAPHY

1. Lee, W. E.: Quart. Jour. Exper. Physiol., 1908, **1**, 335.
2. Flick, L. F.: Fourth Ann. Rep. Henry Phipps Inst., 1908.
3. Seaver, J. W.: Arena, 1897, **17**, 470.
4. Clark, E. L.: Clark College Record, 1900, p. 91.
5. Meylan, G. L.: Pop. Sc. Monthly, 1910, **77**, 170.
6. Lombard, W. P.: Jour. Physiol., 1892, **13**, 1.
7. Florence, P. S.: Columbia Univ. Studies in Hist., Econ., and Law, 1918, **81**, 1.
8. Spaeth, R. A.: Jour. Indust. Hyg., 1920, **1**, 435.
9. Bainbridge, F. A.: The Physiology of Muscular Exercise, London, 1919.
10. Pack, F. J.: Pop. Sc. Monthly, 1912, **81**, 337.
11. Lee, F. S.: The Human Machine and Industrial Efficiency, New York, 1918.

Fink, Bruce: Tobacco, New York, 1915, contains an extensive bibliography on the use of tobacco.

Spaeth, R. A.: Jour. Indust. Hyg., 1919, **1**, 22, contains an extensive bibliography on industrial fatigue.

THE PROBLEM OF EMERGENCY TREATMENT IN SMALL FACTORIES *

A. C. BURNHAM, M.D.

Director, First Aid, Atlantic Division of the American Red Cross, New York City

THE general institution of first aid and early emergency treatment in the large munition factories and shipyards during the war period has been directly responsible for the rapid development of the first-aid movement in the industrial field. Factories which, before the war, made no provision for the care of the injured workman are now installing first-aid stations, and others, which previously made rather ineffectual efforts to provide first-aid treatment, are now, in many cases, establishing elaborate dressing stations with a physician in charge and one or more nurses constantly on duty. In one city of less than 20,000 inhabitants, for example, four industrial nurses are now on duty in place of one before the war period, while in another, a large plant which previously employed only one trained assistant now has a full-time surgeon and two industrial nurses.

Emergency Treatment in Large Factories

In a comprehensive industrial survey made by the United States Department of Labor, which covered 431 establishments employing more than a million and a half workers in thirty-one states, it was found that 375, or 87 per cent., had some form of first-aid equipment. In 110 plants there was first-aid equipment only, and in 265 plants, or 61 per cent., there were fully equipped hospitals or emergency dressing rooms with either a physician or nurse in charge. It was found that in most of the larger establishments, that is to say the plants employing 1000 or more workers, the first-aid treatment was most efficiently handled either by part or full-time industrial nurses.

Dr. C. D. Selby, U. S. Public Health Service, as a result of a detailed study of the surgical care of industrial workers in 155 establishments in the eastern and middle western states, has pointed out the fact that most employers of less than a thousand persons do not as a rule feel justified in employing a full-time surgeon and that comparatively few employ industrial nurses. He concludes that every establishment employing more than 200 persons is justified in having either a part-time or full-time physician and that the physician's services, if he is on a part-time basis, may advantageously be augmented by the employment of a trained female nurse or a person who has been taught to handle the routine work under the physician's direction.

We may conclude from the above mentioned reports:

1. That the larger establishments are making rapid progress in industrial medicine and that the employees will be, within a comparatively brief space of time, adequately cared for.

2. That workers in factories employing from 200 to 1000 persons are, as a rule, fairly well cared for and that any plan for the care of the injured should include the establishment of a dressing station with a trained attendant, together with either a part-time or full-time surgeon who acts as surgical director.

3. That the chief industrial first-aid problem today is the emergency care of the

* Received for publication June 8, 1920.

employees of small factories, that is to say in plants employing less than 200 workers.

While individually such factories represent small units, in the total, the number of employees reaches an enormous figure and the annual wage loss from physical disability, the result of accidents, amounts to many millions of dollars. A few of the small factories, either because of their isolated location or for other reasons, have made special efforts to secure emergency treatment and are now adequately cared for, but on the whole — and this is especially true in the large cities — little or no provision is made in establishments of less than 200 employees for the immediate care of the industrially injured.

First Aid Neglected in Small Factories

In New York, the Industrial Code requires that every factory employing ten or more persons shall have a first-aid kit, conveniently located and, further, that there shall be, in every such factory, an employee who has received instruction in first aid. Many other states have similar requirements but, owing to the difficulty of carrying out the practical details, first-aid treatment in small factories is often slighted or neglected entirely. In smaller communities it is the ordinary custom to send injured workers to a nearby physician for treatment. This often entails a trip of a mile or more, and frequently a wait of several hours or even longer, before the physician can be seen. In cities, injured workers are usually sent to the emergency room of the nearest hospital. In some cases this represents a trip of several miles and a delay of an hour or more.

The disadvantages of both of the above methods of first aid are at once apparent. The delay not only causes loss of blood and an increased tendency to infection but, in severe injuries, greatly increases the severity of the degree of traumatic shock. In addition, the difficulty of securing treatment causes neglect of minor injuries with occasional severe infections and prolonged disability as a consequence thereof. In New York City it is not uncommon for a patient to present himself at the hospital emergency room with a badly infected wound, three or four days old, which has had absolutely no treatment since its occurrence.

The industrial first-aid problem, then, which presents itself to the community, is the care of the injured of smaller factories. Employers of large numbers of workers may, as a rule, be expected to see the benefit of first-aid treatment and to make necessary arrangements for its installation, but the care of the injured of the small factories presents a community problem which is only being partially met under existing conditions and which must be solved by co-operative action of employers, industrial workers and the community at large.

Plans for Emergency Treatment

There have been several plans advocated for the solution of this problem. They may be classified under three general headings as follows: (1) the Red Cross method of promoting instruction in first aid among industrial employees; (2) the medical commercial method of securing emergency treatment; (3) the establishment of municipal or community first-aid stations.

1. *Instruction in First Aid.* — The method adopted by the American Red Cross is intended so to train a given number of carefully picked employees in various factories that they may be fully prepared to administer intelligent and efficient first-aid treatment immediately after the accident occurs. In addition, training in first aid is to be extended as far as practicable to the household and the school so that not only especially chosen employees may be qualified in first aid,

but that also many of the wives and mothers and practically every high school graduate may have a reasonably clear understanding of the control of hemorrhage and the dangers of wound infection. The equipment recommended by the Red Cross is a standard industrial first-aid box for factories, a somewhat modified box for schools, and another for household use.

The plan as advocated consists of classes organized by the local chapter and taught by local physicians. In the case of industrial establishments, such classes are ordinarily taught by the plant surgeon who is paid by the employer. Where this is impossible the local Red Cross chapter sometimes organizes the classes to include the employees of several different firms, in which case a small fee may be charged or the chapter may bear the entire expense. Plans similar to those now being carried out by the American Red Cross are also being developed by other national and local organizations.

2. *The Medical Commercial Plan.* — This plan contemplates the establishment throughout the community of numerous dressing stations under the control of one or more of the local surgeons. Either a nurse or a trained attendant is placed in charge and a physician is employed on part-time or full-time duty, depending on the amount of work to be done. If no physician is present when a patient applies for treatment, first-aid treatment is given and the patient sent either to a nearby hospital or, if the condition permits, allowed to wait for the surgeon who is summoned at once. Such a plan may originate with a group of employers who, seeing the need for treatment, combine in paying the expenses; it may originate with a physician or group of physicians who, on their own initiative, establish a series of dressing stations in order to regulate their work and to control properly their cases from a purely business standpoint; or, in a few cases, insurance companies may set up a similar plan, establishing local dressing stations in connection with small community hospitals for the treatment of employees working in various establishments but all insured by the same company. It is reported that the savings in losses due to disability fully repay the insurance company for the expense incurred.

The advantages of this plan are clearly evident; it secures early and adequate treatment for the injured worker and allows the physician to work under the best conditions. The disadvantages are that it is largely commercial and that differences of opinion in regard to expenses and fees are almost certain to occur, and further that it is frequently difficult to convince the small employer of the necessity for this service.

3. *The Community First-Aid Station.* — By a community first-aid station is meant a conveniently located place where patients may receive emergency treatment and temporary care before being sent to their homes or to the hospital. It should theoretically consist of a small room with two or more cots and supplies for ordinary dressings. Sufficient equipment to supply light nourishment, such as hot coffee or broth, is desirable. The equipment, of course, varies considerably according to the local requirements.

First-aid stations may be located in villages or small towns where there is no hospital or, in cities, in localities where hospitals are not easily accessible. In some cases they may be established by the local community, in others by some of the local industries, and in others they may be simply branches of the local hospital. In a few cases railroads have established such stations for the benefit of their own employees and have made the services of the stations available for others in the community when accidents occur. Stations should be centrally situated and may advantageously be placed in a school building, in

the local library, in police or fire stations, or at other locations where they are convenient to the center of the population covered.

There should of course always be a physician on call and preferably a trained nurse in attendance, but in certain cases, especially in smaller communities where the demand is less acute, the nurse may be replaced by a trained first-aid worker, who is in attendance at the station in addition to other local employment.

Physicians, especially those interested in preventive medicine, may accomplish considerable for the betterment of the health of the community if they will make their influence felt for the improvement of emergency treatment, especially for those injured in industrial employments. If each physician makes a study of his own particular locality and attempts to stimulate community effort for the immediate care of the injured, the result will be not only a diminished wage loss due to accident but the actual saving of human life.

REVIEW OF THE RECENT ADVANCES IN INDUSTRIAL MEDICINE AND SURGERY*

Proposed Scheme of Application of these Principles in a City of Small Industries

JAMES E. M. THOMSON, M.D.
Lincoln, Nebraska

INDUSTRIAL medicine and surgery as branches of the science of medicine are of but recent origin. Yet their recognition as entities has been firmly established during the past few years, and the scope of their activities is so far-reaching that they are intimately allied with the best interests of public health, labor, progressive business and increased production. Industrial medicine and surgery may be defined as the theory and practice of medicine as applied to the prevention of illness and accident among industrial workers, the prompt restoration of workers to productive activity when illness or accidental impairment have occurred, and the constant maintenance of the highest efficiency of the human element in industry.

Among the recent stones laid in the building of their broad recognition is the establishment in the University of Cincinnati of a Department of Industrial Hygiene. This department was equipped and is maintained by subscription of the various manufacturing concerns of the city of Cincinnati. Like departments are integral features of Harvard and Rush Medical Colleges, and efforts are being made for the establishment of courses on this subject in other medical colleges and institutions of learning as the growing need for trained industrial physicians becomes ever more urgent.

Further, journalism peculiar to this field has been developed. The industrial departments of the magazines, *Modern Medicine* and *Hospital Management*, are a dominant feature of these publications. *The Journal of Industrial Hygiene* devotes its entire space to medical industrial problems. One of the greatest contributions to medical literature for the year is *Industrial Medicine and Surgery* by Dr. Harry Mock of Chicago.

It is the consensus of opinion among many foremost physicians that the advancement of industrial medicine by both the medical profession and industrial managements will be an outstanding feature of the coming year. Dr. Herbert T. Davis, chief surgeon of the Aluminum Casting Company and other Cleveland industries, says:

> The best of the medical profession have in the past looked askance at industrial work, because of lack of system and business methods in the average doctor's work. Most doctors are individualists in thought and action, and there is a generally prevailing idea that industrial medicine is performed by "down-and-out" doctors, at contract rates enforced by heartless corporations.
>
> The profession is changing its attitude as its members see what can be accomplished by organization and group practice as exemplified and demonstrated by various organizations now existent.
>
> On the side of business, there is the awakening sense that cheap and inferior medical work is not satisfactory in any particular and is often disastrous, and that the best medical talent should be procured. This presages the getting together of the best in medicine and the best in industry, to their mutual benefit.

Dr. Charles A. Lauffer, Medical Director of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pennsylvania, is of the opinion that the industries of any community reflect upon the public health conditions of that com-

* Received for publication May 6, 1920.

munity, hence industries cannot be satisfied unless conditions in the area from which their employees come are satisfactory; and, *vice versa*, the community should not be satisfied if its industries do not minister to the maintenance and elevation of the standards of public health.

A greater recognition of this branch of medicine by the promoters of industry is evinced in the rapid growth of elaborately equipped medical departments, not only in the larger industries but in the smaller institutions as well. To what can such a demand and popularity for this new branch of medicine be attributed? It is indeed true that public opinion, unscrupulous litigation and labor agitation have been responsible, to a certain extent, for the almost universal enactment of accident compensation laws throughout the country. The introduction, however, of medical as well as surgical service, the appreciation of the value of the most efficient lighting, heating and ventilating systems, the earnest effort to prevent occupational diseases among workers — these are not mere philanthropic or charitable donations, but are purely an application of good business principles. The saying, "a man is better than a machine," daily becomes more applicable. The human element of industry is indeed of greater importance than any other factor of production. A healthy man is more efficient than a sick man, therefore more productive. It is a matter of business policy to protect the great human factor of industry and in every manner to promote conservation of life and health as one of the most valuable assets of national wealth.

Among the various answers received from responsible officials to the question, "Why do you maintain a medical department?" as quoted from a recent article by C. D. Selby, M.D. (Consultant in Industrial Medicine and Surgery), are these:

"Purely for service" was the characteristic reply of one of the officials of the Ford Motor Company. "We owe it to our men," said the superintendent of the Toledo Furnace Company. "It is a check on conditions that impair health," testified the manager of the Willard Storage Battery Company. Another sincere reply: "To safeguard the health of workers in the belief that the healthy worker is more efficient." Others wrote: "Constant medical service is insurance against damages," "Health education reduces absenteeism 50 per cent.," "Keeps men on the job," "Reduces labor turnover."

Among the foremost factors, then, which induce managements to offer to their employees medical and surgical service are the following:

1. The acknowledgment of their obligation toward the workers who sustain injuries during the performance of their duties, and the stress brought to bear by legislation, regulating compensation for such injuries.

2. The fact that this service tends to prevent litigation by active interest in the welfare of the disabled, and also reduces the compensation insurance expense.

3. It aids in removing the influences of unrest, promotes goodwill, and reduces the labor turnover.

4. It is capable of preventing loss of time.

5. It enables the worker to produce more.

6. Lastly, it is absolutely essential to isolated industries.

Scope of the Work

The industrial medical department, as successfully worked out in large institutions, includes:

1. The maintenance of first-aid station, hospital and clinical facilities.

2. A staff consisting of two groups:

(a) At the plant

i. Doctors to care for minor ailments and injuries.

ii. Nurses as assistants and for home nursing and care.

(b) Diagnostic clinical group, with every facility for accurate work, consisting of specialists — medical, surgical, dermatological, orthopedic, roentgenological and dental.

3. The treatment of emergency accidents.

4. The treatment of sickness and dental infirmities.

5. The sanitary supervision of the plant.

6. The instruction of employees in prevention of accidents, occupational diseases, home and personal hygiene.

7. (a) The examination of new employees and recommendations as to their physical fitness to perform the expected tasks.

(b) The examination and rating of old employees as a check on their physical fitness.

Practically all the literature on this subject is the result of broad experience with its application in large industries of thickly populated portions of the country or in extremely isolated areas. There are, in fact, comparatively few institutions employing less than 500 persons that maintain full-time medical service. There is reason to believe, therefore, that the managements of small industries have not yet attained the philanthropic attitude of mind necessary, or do not deem the time ripe for the expenditure essential to maintain such service, but prefer detached medical services limited to the care of injuries, with but little or no thought of the physical welfare of their workers.

In order to become more thoroughly acquainted with local conditions in a city of about 70,000 inhabitants, having only comparatively small industries, a questionnaire was addressed to practically all the manufacturing concerns of the city, as well as the larger retail and wholesale business houses, as follows:

1. How many are employed by your company? Of these, how many are clerically employed?

2. Are you protected by workmen's compensation insurance in case of accident to any of your employees?

3. Have you any method of compensation in case of sickness. If so, please outline scheme.

4. Have you a medical department? A dispensary? A first-aid station?

5. Have you ever considered the introduction of an industrial medical department in your institution? Have you any suggestions as to how such a department could be established in manufacturing concerns of less than 1000 employees?

As the information acquired by these replies is regarded as confidential, the names of the firms are withheld. The answers received embrace a limited survey of thirty-four institutions employing 4291 workers, of which number twenty-four have less than 200 employees, and ten between 200 and 550, the two largest employers being in the retail business and the only firms in this class consulted.

The Workmen's Compensation Act of this state protects not only the employee but also the employer, to a certain extent, from the wrongs of unprincipled litigation. It furnishes surgical and hospital care to workers injured in the performance of their duties, also compensation consisting of half-pay after the first week of disability. Should the disability last longer than six weeks, compensation is allowed for the first week. In case of permanent disability, partial or complete, compensation is allowed at a fixed rate, depending upon the amount of impairment of function. The liability for this compensation is assumed by various insurance companies at a very moderate cost, and practically all employees avail themselves of this protection. In fact, every firm from which replies were received is so protected.

There is an institution in this city employing about 250 men and having a benefit association to which each employee may belong by paying 1 per cent. of his wages. If disabled by sickness, the employee receives, after the first week, one-half of his

wages; also, the doctor's and hospital bills are paid by the association. Regular pay during illness is given by a concern employing comparatively few men. Another grants compensation in case of sickness, but does not state how much.

Not a single firm has an organized medical department, yet four institutions have considered such a step. The consensus of opinion, however, seems to be that their institutions are too small to warrant such a venture. The idea, however, of a co-operative medical unit serving several institutions was voiced by one very progressive manager. The statement that physical examination of prospective employees and periodic examination during service would prove valuable in determining the fitness of men for various positions, was also advanced in the belief that this too would aid in promoting efficiency.

Seven institutions have first-aid stations equipped for the care of minor injuries, prior to sending the injured to a doctor's office. This limited service is carried on by trusted persons who happen to know something of the principles of first aid. Several firms have first-aid cabinets, and one firm with a rather peculiar hazard has men trained in resuscitation and the use of the lung-motor.

The almost universal interest demonstrated by officials in making their replies to this questionnaire has convinced me that the advisability of medical as well as surgical service, and some manner of compensation for sickness, is realized; but a plan for the establishment of such service is a problem for which they offer no solution.

The medical departments of large institutions have approximately one physician to each 200 to 500 employees, as many nurses, and half as many attendants. It would not, therefore, be unreasonable to expect organizations employing 200 to 500 persons to maintain a medical department offering at least part-time service. Such a department would, however, be out of the question for establishments employing less than 200. Apparently for a community such as ours, made up mostly of small industries, any effort to offer adequate industrial medical service should be of a co-operative nature. Various attempts in this direction are being made by manufacturing associations and by retailers' and wholesalers' associations, an example of which is the Central Manufacturing District of Chicago. This is an organization comprising a number of the smaller industries located in a certain vicinity of Chicago, the basic purpose of which is to render shipping and switching service. Other functions have been centralized in this organization, among these being medical service, a dispensary situated in the district, and an ambulance, thereby offering immediate medical attendance available at all hours. The Manufacturers' Association of Erie, Pennsylvania, maintains a compensation and casualty insurance for its members. Co-operative traffic bureaus, furnishing ratings, freight routing, tracing of lost shipments, etc., have been successfully worked out by manufacturers. The function of these bureaus has in some instances broadened to embrace employment agencies and to furnish physical examination and physical rating of applicants, liability insurance, and even medical service.

This paper is merely an attempt to bring to your attention the advances, recognition, and good business policy of industrial medicine and surgery, with the hope that more light may be shed on a plan of application to the industrial medical problems of a small city. The following scheme outlines a plan for a co-operative industrial bureau with a medical department adaptable to the needs of a city of small industries.

A Proposed Plan for a Co-operative Industrial Bureau with a Medical Department Adaptable to the Needs of a City of Small Industries

Administration

Chief Executive, or Director of the Bureau
- Employment Department: director in charge, and co-workers
- Insurance Department — health and accident: director in charge, and co-workers
- Medical Department: director in charge

Group I

Consists of a completely equipped diagnostic machine, including laboratories needed and hospital affiliation.

Personnel
- (a) Professional:
  - Internist
  - Orthopedist
  - General surgeon
  - Roentgenologist
  - Dentist
  - Hygienist
  - Nurses
  - Attendants

  Duties:
  - Examination of prospective employees
  - Diagnosis and treatment of sickness and dental infirmities
  - Care of accidental injuries
  - Sanitary supervision of plant
  - Instruction of employees
- (b) Administrative:
  - Bookkeepers
  - Stenographers
  - Clerks

Group II

Presupposes the division of the industrial work of the city into districts, each in charge of a district surgeon, whose duty it is, with the aid of a nurse, to attend the injured and sick in the various industries, referring severe injuries and doubtful ailments to Group I for diagnosis, treatment or hospitalization.

Such a plan involves an initial outlay of a large amount of capital. However, if the organizations co-operating in such a scheme should represent something over 5000 workers, the relative expense and upkeep would be fairly moderate, while the satisfaction derived from such a project should be overwhelming.

THE VENEREAL CAMPAIGN AMONG RAILWAY EMPLOYEES *

ARCHIBALD E. CHACE, M.D., F.A.C.S.

Chief Surgeon, St. Louis Southwestern Railway Lines, Texarkana, Arkansas-Texas

THE problem of reducing the incidence of venereal disease among railway employees may best be considered from three points of view: (1) educational, (2) prophylactic, and (3) curative.

I. Educational Program

The educational program outlined so well by the United States Public Health Service should properly be considered under prophylactic measures, were it not for the intrinsic importance at the present attached to this work. To be effective, the purpose of this education must be to create a public demand that venereal diseases shall be managed as communicable and therefore quarantinable affections. The whole program will fall flat unless this goal is achieved. Such an end result is unhappily delayed several years by one of the weak points of our form of government which, like the exception to the rule, proves the wisdom of it. We have laws, federal and state, by which in a few weeks an autocratic administration could obtain the result sought, yet we must painfully and expensively educate these laws into effectiveness. The by-products of this education are only a little less valuable. The quack and the advertiser are seeking shelter elsewhere. The legitimate medical profession and the hospitals are learning that they have a duty to the patient with venereal disease — a duty not alone to treat but to treat adequately. The mystery of sex relationships and their disorders dissolve slowly in fuller knowledge. Above all the sham of shame is displaced by the discovery of a contagious disease.

To the physician who has thought loosely about venereal problems, to the employers and leaders of labor, there is coming a realization of the largely decreased labor output, the actual loss of time, the frightful aggregate of suffering, the cause of many accidents, and the contagiously disgruntled and reckless disposition which accompany the most widely distributed diseases known in man.

A glance at these objects of the educational program will convince anyone that the dangerous occupation of railroading, involving the utmost care for the safety of the traveling public, is most directly concerned. The conferences lately held by the Committee on Health and Medical Relief of the United States Railroad Administration and the United States Public Health Service with railroad representatives have shown a few ways in which the railways may assist the government, and themselves, to rid this country of its greatest plague. Meetings between the employees and representatives of the medical department, circulars and posters, venereal disease clinics in shop towns, motion picture shows on the subject, and close co-operation with state and federal agencies, comprise the educational program worked out at these meetings.

The St. Louis Southwestern Railway, from the venereal point of view, occupies the unique position of the only railroad in this or any other country, so far as I know, which gives a full service. Before the present campaign, an educational program, a very limited prophylactic service and a complete curative service were maintained by this road. The results are shown in the accompanying tables of

* Read before the Southeast-Missouri Medical Association May 5, 1920. Received for publication June 4, 1920.

statistics. (Tables 1 and 2.) You will notice that the end results are not all that could be wished. For this there are, of course, reasons. Physicians do not like to treat venereal diseases. This attitude leads the patient to think even more lightly of his ailment than is his too frequent custom.

TABLE 1. — STATISTICS OF CASES FROM FREE VENEREAL SERVICE AT TEXARKANA HOSPITAL, MEDICAL DEPARTMENT, ST. LOUIS SOUTHWESTERN RAILWAY LINES

Disease	1918 New Cases	1919 New Cases	Per Cent. Increase	1919 Per Cent. Cured	1919 Per Cent. Probably Cured	1919 Per Cent. AWOL
Syphilis	56	86	53	0	0	79
Gonorrhea	83	125	50	0	25	69
Chancroid	18	29	61	48	10	38
Other venereal disease	..	1	..	100		
Total or average	157	241	53	6	14	69

TABLE 2. — COST OF VENEREAL SERVICE AT TEXARKANA HOSPITAL, ST. LOUIS SOUTHWESTERN RAILWAY LINES

Disease	Cost 11 Months, 1919	Cost per Case	Cost to Complete Case
Syphilis	$5,235.49	$66	$200
Gonorrhea	5,695.95	50	125
Chancroid	953.81	35	50
Other venereal disease	29.90	30	...
Total or average	$11,915.15	$54	$143

Laws intended to insure adequate treatment have not been enforced, and it is impossible to keep track of the majority of venereal patients until a cure is reached. Among railroad employees this is particularly true because of the distances covered almost daily, the change of runs and tricks, the almost constant reinfection, and the labor turnover.

To educate what may be called venereal responsibility into railroad employees, placards—like the one below—have been placed in toilets, circulars have been sent to each employee, and follow-up letters to the men known to be infected. Above all, personal talks with the men probably give the best results.

BULLETIN NO. 2

FREE VENEREAL SERVICE

OF THE

MEDICAL DEPARTMENT

OF THE

ST. LOUIS SOUTHWESTERN RAILWAY LINES

Employees suffering with gonorrhea, soft chancres and syphilis should apply to their foremen for Red Cross Certificate, obtain pass from agent, and come immediately to the St. Louis Southwestern Hospital at Texarkana. You should arrange to spend several weeks if necessary at the hospital, because these diseases may be serious to yourself if neglected, and usually the treatment is more effective while you are resting. Moreover, these diseases are contagious or infectious, and you owe it to your fellow employees to come to the hospital and get a complete cure.

The employee who is unfortunate enough to become infected with a sexual disease, and takes his treatment like a man, is not looked down upon.

II. Prophylactic Measures

The reason that syphilis is eight times as prevalent among railroad employees as among farmers * is probably largely due to the housing problem. At the end of runs away from home, the boarding house is too frequently the home of prostitutes. The railroad Y. M. C. A. houses are of course intended to supersede this evil, and to some extent do, yet the total effect is small in comparison with the whole problem.

Treating infected women under strict quarantine has been carried out by the U. S. P. H. S. with some success. The real effect of this prophylactic measure will never be realized until men are placed upon the same footing as women and receive the

* J. H. Stokes and H. E. Brehmer: Syphilis in Railroad Employees, Jour. Indust. Hyg., 1920, 1, 419.

same treatment. The man who takes his treatment faithfully under a competent physician does not need strict quarantine. The man who fails to consider the rights of others must be placed under restraint. The same statement applies equally to women.

The greatest single prophylactic measure known has been discarded by the U. S. P. H. S. The prophylactic treatment, or early treatment, is not encouraged for two reasons: the supposed opposition of the church and of moralists arguing that one cannot preach continence and at the same time offer a safeguard for incontinence; and, secondly, the claim that prophylactic treatment is only 50 per cent. efficient. These objections are so important to this campaign that one cannot pass them by without answer. The first objection is practically annulled by the experience of Pennsylvania where the early treatment is advocated and packages for self-medication, endorsed by the state Department of Health, are sold in the drug stores. In that state there has hardly been a voice raised against the method, and I have not heard anyone accuse the 9,000,000 people of Pennsylvania of less religion or morality than may be found in other states. Moreover, to preach continence may be, and is, a good measure, but what about the boy or girl who has not listened? Must he be condemned to syphilis or gonorrhea? Morality has sunk to a very low level when it prohibits the best possible relief from the consequences of not following the advice of morality.

Is early treatment only 50 per cent. efficient? The many years' experience of the Navy is not in accordance with such a statement, and the only reason I can see that the Army in the recent war may have had such an experience in France is poor quality or tardy treatment or poor records. In the case of treatment within six hours in private practice, I believe 90 per cent. efficiency would be more correct. But for the sake of argument, let us suppose that it is only 50 per cent. efficient. Does anyone know any other measure which can now be practically applied which gives 10 per cent. efficiency? The two arguments against this effective early treatment are the result of sentimentality rather than morality on the one hand, and of an utter lack of perspective on the other.

The final difficulty seems to lie in the reporting of venereal diseases, and here the state of Pennsylvania has departed from the program of the U. S. P. H. S. Dr. Martin, Health Officer of Pennsylvania, believes that physicians are not yet ready to report venereal diseases. Let me ask — If the most widely disseminated communicable diseases known in man should not be reported, then why report any infectious disease? All the arguments for reporting communicable diseases other than venereal apply with added force to syphilis and gonorrhea. If members of the medical profession are not ready for reporting venereal diseases, are they ready for the practice of medicine at all? Do they deserve a license from the state? Are they just to the patient and to the community? The medical profession is, I believe, ready for it, but the half-hearted manner in which the venereal laws have been enforced has led many to believe that these laws are a dead letter. The manner in which at least some of our pharmacists have been approached by the agents of the U. S. P. H. S. has left the impression that these laws never were meant for enforcement. Do not blame the profession for a weak executive force.

To summarize: This campaign needs every prophylactic measure known to be of real efficacy, broad moral education, the reporting of all cases, complete treatment, and segregation with forced treatment for the unruly and for chronic carriers, male and female.

III. Treatment

It is hardly necessary to enter into the treatment of gonorrhea here, except to express the wish that it were much more efficient. With syphilis one has much greater difficulty in completing treatment because of the minimum of two years of active medication. This fact is very difficult for the average man to realize after all visible and subjective symptoms have disappeared. Here again the thorough enforcement of existing laws would greatly assist. The minimum standard which we have adopted in the St. Louis Southwestern Railway lines is very similar to that advocated by the U. S. P. H. S. except that we have found the elder Keyes' method of giving mercury by mouth more practical in railroad men. We try, however, to give as much as possible by deep intra-muscular injection. The important point in treatment, of course, is completeness. Our venereal technician and our physicians are instructed never to discharge a case of gonorrhea until at least two smears taken after thorough prostatic massage are found negative, and in no case of syphilis should the case be lost until the course of treatment is complete and at least several negative Wassermanns are obtained.

In conclusion, let me make a plea for a more energetic enforcement of the laws written on the statute books of some forty-seven states for the protection of the public against venereal diseases. You may not know that many railroad men in the beginning were afraid that the labor leaders would make trouble about a venereal campaign among railroad men. On the contrary, these leaders have enthusiastically supported us, and I have faith that they will support every measure honestly carried out for the protection of labor. Up to date this campaign has been most cautiously approached. It seems to me that the time is about ripe for less of this caution, for less of a jelly-fish spine among officials. If we have a measure which is even only 50 per cent. efficient, as some would have us believe, for the good of humanity in ridding this country of the greatest plague ever known, let us use it. If physicians will not report venereal diseases, the time is at hand to prosecute them. If patients have not sufficient responsibility to abstain from stealing their neighbors' health, we should apply the same executive treatment as we do apply to those who steal their neighbors' wealth. To go on as we are now, condoning the infraction of laws which are in effect, passing by the greatest weapon because of supposed opposition, and in one state at least openly avoiding the reporting of these communicable diseases, we are inviting disaster. This campaign, as I see it, is making headway far too slowly. It needs the injection of punch. The U. S. P. H. S. mapped out these very laws, and it has been of the greatest assistance to us. We owe it a debt of gratitude. The way to help is to insist, to demand, that these laws be enforced. They were not written to make sport of.

Gentlemen, let me leave this plea with you. If you have any conception of what venereal disease means to the welfare of this country, of the amount of lawlessness which it causes, of the great loss to industry, of the suffering of wives and of children, of the financial ruin of families, of the cost to the state for the care of tabetics and the insane, forget the sham of prejudice and look upon this plague as you would upon any other contagious disease — report it, quarantine it if necessary, use every measure of prevention, and treat it adequately. Then only will you do your duty to the state which licensed you to practice the art and science of medicine — the state which has a right in return to expect that you guard faithfully the well-being of the commonwealth.

SUB-STANDARD WORKMEN *

W. IRVING CLARK, JR., M.D.
Medical Director, Norton Company, Worcester

SUB-STANDARD workmen may be divided broadly into three classes: those who are sub-standard mentally but standard physically; those who are sub-standard physically but standard mentally; those who are sub-standard both mentally and physically. The problem is how we can make use of these men in industry and at the same time make them better workers and stabilize the large existing turnover which they create by wandering from one place to another.

The acute shortage of labor which occurred during the war and which exists today has made manufacturers appreciate a problem which up to that time had never come to their notice with sufficient force. The production of the country requires the use of every individual and requires his use to the very best of his capacity. Unless a sub-standard worker is properly placed, he is either an inefficient worker and, therefore, discharged by his foreman, or he becomes dissatisfied because of his physical inability to do the work and leaves the organization to try elsewhere.

This constant shifting is one of the great overhead expenses of industry. Alexander has shown that the average cost to the employer of every change of position is at least $35. No statistics have been obtained as to the cost to the employee, but the combination of time lost from actual work, expenses which continue during his period of non-work, his traveling expenses as he moves from place to place, and his decreased earnings as he familiarizes himself with a new shop, must amount in each individual case to more than the sum which it costs the employer. The solution is the proper placing of the sub-standard worker in industry and the ability to hold him in this position with a minimum amount of change.

If we consider our first classification from this point of view, it is evident that the man who is mentally sub-standard but physically standard can usually be placed without difficulty at heavy work requiring no particular mental ability. There are very many places of this type open in every industry, and if the work and wages are attractive there should be no difficulty in holding the man for a considerable period of time.

Where the mental condition is standard but the physical condition is sub-standard, the problem falls upon the industrial physician and it is with this class that he is able to do his most effective work.

When both mental and physical condition are sub-standard, the applicant is usually unfitted to work in any department of the factory, and it is advisable for his own good and that of industry that he turn his work into other fields.

Every factory of any size whatever is divided into departments. The type of work in these departments varies. If the type of work is analyzed it is found that there are two broad types, light work and heavy work; and if these are further subdivided they will be found to consist of light work with and without special hazards, such hazards being dust, heat, humidity and other physical conditions which militate against the health of the worker. Heavy work may likewise be divided into heavy work in which there is a good general working condition, and heavy work in which the working conditions are poor. It is evident, therefore, in placing a mentally standard and physically sub-standard man,

* Received for publication April 29, 1920.

that the particular type of work for which he is physically fitted should be found if possible. If such an effort is seriously made by the industrial physician in consultation with the employment manager, a large amount of unnecessary discomfort to the workman, sometimes resulting in ill health and even danger, may be avoided; while from the point of view of the employer, a more contented worker and one who will remain more steadily on his job will be produced. In other words, proper placing should reduce turnover.

How is this proper placing to be accomplished? It is evident that no one by a casual glance can tell whether a workman is sub-standard physically or not. A careful and yet rapid physical examination is the only method by which the industrial physician can determine the risk of the applicant. In most factories where physical examinations are used, applicants for examination are classified into four great groups which are designated by the numbers, 1, 2, 3 and 4, or the letters, A, B, C and D. The first group consists of those men who are mentally and physically standard. The second group consists of men who are mentally and physically sub-standard but not enough so to militate against their employment in any department in the factory. The third group consists of those men of whom we have just been speaking, namely, those who are mentally standard but physically sub-standard to such a degree that placing in some particular department is necessary. The fourth group consists of those who are so far sub-standard mentally or physically, or both, that they cannot be employed anywhere in the factory with safety to themselves, to others, or to property.*

The doctor, after his examination, having determined into which one of these four groups the worker falls, has two methods of procedure: First, he may write a prescription of the type of work which the applicant is physically able to do, or, second, he may confer with the employment manager as to the exact job upon which the applicant should be placed. In a large factory it is possible to place all but 0.5 per cent. of the applicants, and these will fall in the fourth of our original classifications, or Class D — namely, men who are unable to work in any department because they are mentally and physically sub-standard, or are so sub-standard physically that there is no department in which it is safe for them to work. Ability to place men properly depends upon the industrial physician's knowledge of the work in the various departments, and this knowledge can only be obtained by familiarity with the work and by experience.

Sub-standard men usually fall into one of the following classifications: cardiac, nephritic, pulmonary, hernial, syphilitic, special, and general.

Cardiac cases which are unable to work are relatively few. Our experience confirms that of MacKenzie that hearts, even though they show, on examination, marked murmurs and even irregularities, are usually able to stand moderate work for a number of years before showing signs of disturbed compensation. The industrial physician should not only be interested in what he hears with a stethoscope, but should endeavor to ascertain the condition of the myocardium. Though this is an extremely difficult thing to determine in a short examination, a functional test in suspicious cases will usually give a lead in the right direction. We have found that the army test of hopping the applicant fifty times on one foot, examining the heart before and after exercise, and noting particularly the rapidity of the pulse, its force and regularity, and the time required for it to fall to normal, is the most valuable crude method which we have at present of determining the function of the myocardium.

* Classification of C. C. Burlingame, Service Director, Cheney Bros.

But more important than the action of the pulse is the reaction of the respiratory center to this moderately violent exercise. A patient who becomes breathless or shows any signs of abnormal breathing after this exercise, as compared with the normal man, is one who should be studied with great care and who should not be assigned work which will throw any strain upon the heart. This point of breathlessness has been emphasized by Lewis in his recent monograph on *The Soldier's Heart and the Effort Syndrome.* The exercise also immediately shows up any cases of that mysterious condition known in the army as neuro-circulatory-asthenia, the familiar N.C.A. Though many of these cases were met in the army, I have seen practically none in industrial work. They should, however, if met, be immediately rejected as they have no business in the hard work of industry.

Nephritic. — Nephritic patients can be most rapidly discovered by blood pressure determinations. A good general rule is to make a blood pressure determination on all men of 40 or over, and urinalysis on all those showing a pressure of 140 systolic, 90 diastolic. Nephritic cases cannot stand the extremes of heat and cold which exist in many departments nor have they the resiliency against hard work that the normal individual has at the same age.

Pulmonary. — The most frequent pulmonary condition found among sub-standard men is a latent tuberculosis. This may be discovered by a combination of the patient's general build, physical signs in the chest, and breathlessness on exertion. Again, we see the advantage of putting the patient through the fifty hops on one foot, and by this simple method we are able to judge two conditions, cardiac and pulmonary. Applicants with latent tuberculosis can be employed in numerous departments in the factory, but should certainly not be put in a dusty, dark or humid workroom. If kept in a bright, dry workroom they are able to do excellent work without breaking down.

Hernial. — One of the most perplexing conditions which the industrial physician encounters is hernia. Our general rule has been to be extremely careful about admitting men with hernias into industry, partly on account of the compensation risk in cases of strangulation, partly on account of the necessity of repairing the hernia if the man complains of pain after lifting, even if there is no increase in the size of the hernia, and partly because where there is a hernia on one side, there is usually a tendency for a hernia to appear on the other side. Compulsory use of trusses cannot be enforced, so that in the majority of factories there has been a strong feeling against the man who has a hernia. At the Norton Company we have made careful investigation of our hernial risks and as a result of our experience we have come to some conclusions which are rather opposite those usually held. We have found that the majority of our hernias have come from men who entered the company with no sign of hernia whatever, but in whom a hernia has gradually developed while at work. This has been particularly noticeable in the southern Europeans. Among the men who have hernias — some of them large hernias — who were in the employ of the company when physical examinations were first started, we have had no trouble whatever, and recently we have gone so far as to admit applicants for practically any position in the factory who have complete hernias, providing they have been doing heavy work up to within one week of their commencing work at the Norton Company. We find that the majority of these men who have old fifth-degree hernias wear trusses, are familiar with the application of these trusses and take care of themselves, and that they are, on the whole, less risk than the southern European with a weak exter-

nal ring or weak muscles in the region of the rings. Our experience may prove that we have made a mistake in this, but so far our judgment has produced satisfactory results.

Syphilitic. — A diagnosis of tertiary syphilis is very difficult in the short examination which is given the average applicant. However, if the factory hospital is used as it should be, cases are constantly appearing in which there is enough to arouse the doctor's suspicion and lead him to take a Wassermann. These cases, if the Wassermann is positive, should immediately have salvarsan, following which the type of work at which the patients are placed should be carefully investigated. We have found a number of these cases in which the mental degeneration was considerable, rendering the man a danger to himself and others. He will, however, often clear up rapidly after medication and become able to resume, first, light work, and then his original occupation.

Special. — There are naturally a number of conditions which do not fall in any of the above groups, but which, nevertheless, require careful placing. These are too numerous even to mention, but will readily occur to any industrial physician. A typical example would be varicose ulcers of the leg. These may be placed at moderately light work, and with protection do extremely well, the ulcer healing up rapidly under daily cleansing at the hospital and proper support. Flatfoot is another condition in which combination of placing and support gives excellent results. Our own experience goes to show that flatfoot is more a theoretical than a real detriment to good work.

General. — There are always a number of cases which present a combination of conditions which can only be cited as general. Many of these patients fall under class four group, and really have no business to work anywhere in the factory. Others may be placed and a moderate amount of good work obtained from them. Proper placement does not finish the doctor's responsibility. These sub-standard men must be examined from time to time to see that their defects are not increasing and that the placing has been proper. Such an examination should be made as a routine twice a year; and at each examination a record should be made showing the patient's condition. The doctor should take enough time to discuss with the patient his findings, and to give advice as to how the patient may maintain himself in good condition. If the patient has confidence in the doctor and medical service, and has been thoroughly explained the symptoms which mean beginning trouble, he will present himself for examination long before there are any real signs of breaking down.

In closing, I would point out that the problem of the sub-standard worker is one which can only be solved by the industrial physician and the employment manager, and then only by enthusiasm, careful work and strict co-operation.

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Syphilis and Public Health. By Edward B. Vedder, A.M., M.D., Lieutenant-Colonel, Medical Corps, United States Army. Published by permission of the Surgeon-General, United States Army. Cloth. Pp. 301 and index. Philadelphia: Lea & Febiger, 1918.

Pathogenic Microörganisms. A Practical Manual for Students, Physicians and Health Officers. By William Hallock Park, M.D., Professor of Bacteriology and Hygiene, University and Bellevue Hospital Medical College, and Director of the Bureau of Laboratories of the Department of Health, New York City; and Anna Wessels Williams, M.D., Assistant Director of the Bureau of Laboratories of the Department of Health, Consulting Pathologist to the New York Infirmary for Women and Children; assisted by Charles Krumwiede, Jr., M.D., Assistant Director of the Bureau of Laboratories, Assistant Professor of Bacteriology and Hygiene in the University and Bellevue Hospital Medical College, New York City. Cloth. Pp. 786 with illustrations and index. Philadelphia: Lea & Febiger, 1920.

Prices and Price Control in Great Britain and the United States during the World War. By Simon Litman, Professor of Economics, University of Illinois. Carnegie Endowment for International Peace. Preliminary Economic Studies of the War, No. 19. Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Paper. Pp. 331 with index. New York: Oxford University Press, 1920.

The Physiology of Vision. With Special Reference to Colour Blindness. By F. W. Edridge-Green, M.D., F.R.C.S., Oculist London Pensions Boards; late Chairman Ophthalmic Board, Central London Medical Boards, National Service; late Member International Code of Signals Committee; late Hunterian Professor of the Royal College of Surgeons, etc.; Inventor of Colour Perception Spectrometer, Colour Perception Lantern the Official Test of the Navy; and Bead Test, the Test of the National Service. Cloth. Pp. 280 with illustrations and index. London: G. Bell and Sons, Ltd., 1920.

Hygiene: Dental and General. By Clair Elsmere Turner, Assistant Professor of Biology and Public Health in the Massachusetts Institute of Technology; Assistant Professor of Hygiene in the Tufts College Medical and Dental Schools. With Chapters on Dental Hygiene and Oral Prophylaxis by William Rice, Dean, Tufts College Dental School. Cloth. Pp. 400 with illustrations and index. St. Louis: C. V. Mosby Company, 1920.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | NOVEMBER, 1920 | NUMBER 7

HEALTH IN MERCANTILE ESTABLISHMENTS. I. THE GENERAL PRINCIPLES OF STORE MEDICAL SERVICE*

ARTHUR B. EMMONS, 2D, M.D.

Director, Harvard Mercantile Health Work, Boston, Mass.

On December 1, 1919, under a co-operative arrangement between the Division of Industrial Hygiene of Harvard University and a group of twenty-five merchants, an investigation of health conditions and the problems of health conservation in stores was begun. The following report is the first of a series which will be issued covering this work.

The rise of industrial medicine represents one of the most recent and promising developments in preventive medical science, and since this rise has had its inception in the problems of industrial surgery and accident prevention it is natural that the store with its minimum requirements in these lines should have felt the impetus of the movement later than the factory, where such problems are in constant view. As a consequence of this situation, store medicine and hygiene, except in a very few establishments, has either failed to rise at all or has lagged so pointedly as to lack many of the prime elements of service which it is capable of rendering. A frank realization of this condition caused the following twenty-five firms to co-operate in exploring the entire field of mercantile health:

Chandler and Company	Boston
Chandler and Farquhar	Boston
Conrad and Company	Boston
Continental Clothing House	Boston
D. R. Emerson Company	Boston
Wm. Filene's Sons Company	Boston
The Gilchrist Company	Boston
The Halle Bros. Company	Cleveland, O.
L. P. Hollander and Company	Boston
Jos. Horne Company	Pittsburgh, Pa.
C. F. Hovey Company	Boston
Jordan Marsh Company	Boston
Lord and Taylor	New York City
Leopold Morse Company	Boston
F. P. O'Connor Company	Boston
L. S. Plaut Company	Newark, N. J.
The Shepard Stores	Boston
A. Shuman and Company	Boston
E. T. Slattery Company	Boston
Smith Patterson Company	Boston
R. H. Stearns Company	Boston
Wm. Taylor, Son and Co.	Cleveland, O.
R. H. White Company	Boston
T. D. Whitney Company	Boston
Woodward and Lothrop, Inc.	Washington, D. C.

THE NEED FOR STORE MEDICAL SERVICE

There is no type of organization which makes closer contact with the public and

* The second article in this series, *Health in Mercantile Establishments: II. Medical Records*, will appear in the December issue of the Journal of Industrial Hygiene. — *Ed.*

which depends more upon the goodwill which such contact should engender than does the store. Goods must be sold to the public in such a manner as to insure future dealing, and it is only through the possession of an intelligent, pleasing sales force, a well-systematized clerical staff, and a backing of thoroughly balanced executives that the delicate relations of efficient selling can be maintained. The part which good health plays in such a field of endeavor is unquestionably very large. The factory employee who is ill may fail in the production of goods, but the ailing salesman or saleswoman may not only fail to make sales but may also lose the goodwill of valued customers. It requires very little examination to realize that minor illness is a large and constant attendant upon store work. A sample monthly record from a store employing 700 individuals is as follows:

July, 1920

Number of working days	22
Treatments by store nurse	240
Treatments by physician	70
Total	310
Per cent. of total employees	44.5
Referred to hospital	5
Referred to family physician	2
Referred to outside physician	3
Sent home because of illness	3
Rest room cases	24
Accidents involving compensation	3
Emergency floor calls	2
Heads of departments or executives treated	40
Customers treated	2
Need for visiting nurse service shown by:	
Absences reported as illness	32
Absences reported as family illness	8
Total	40

In another store employing 3,000 the attendance at the dispensary averaged about 200 daily, amounting in one month to over 4,300 or 1.2 visits per employee. Only fifteen of these were accidents of a moderately severe nature, the great bulk representing minor ills.

Manufacturers have made but few attempts to determine what fraction of their labor turnover may be ascribed to preventable illness and the stores with even less statistical knowledge in regard to illness have not approached such accounting. There are, of course, abundant data upon turnover *per se*, and apparently an average turnover of 100 per cent. is not excessive for a large store. If 3,000 individuals are employed, this means that 3,000 are hired annually in order to keep the working force intact, and, since each new employee means a cost of not less than $50, the loss so represented is enormous. That ill health must play a very large part in causing both turnover and absenteeism is certain, and one of the efforts of the group of stores involved in these studies should be to gain a correct estimate of the economic loss so sustained.

In order to attain such an end, records of illness must be kept by the physician in charge. It is sometimes held that the institution of record keeping by the doctor's office will result in a fear of the medical service supplied, the employees feeling that such records may be used against them by the firm. An objection such as this can readily be furthered by a tactless or pedantic store physician whose whole attitude enforces the idea that he is keeping this, that, or the other record for the sake of the records and not for the sake of the patients. While the physician's record should have a useful place in store accounting and in directing the activities of the medical department, it possesses equal value for the patient. Lack of individual records must hamper the store physician in treating a case, just as it must hamper the physician in private practice or the physician in the dispensary or upon the wards of a hospital. Industry has found it increasingly worth while to

record illness, and in organizations where the employees have partial control of the medical service record keeping is not relaxed. Nothing could be more deplorable than the institution of measures resulting in loss of confidence in the medical department by the employees, but such a loss of confidence will rarely occur and will never persist provided the physician in charge is a big enough man for his work. If disaster attends this phase of store medical service it has been caused by the selection of the wrong man or woman for the medical department and not by adherence to methods successful in industry, in private, and in hospital practice.

The Utility of Medical Service in the Stores

Without going into the details of the medical department, we may summarize its main points of usefulness as follows:

1. It should insure good sanitation, ventilation, and other conditions conducive to health and favoring efficient work with a minimum of fatigue. With these points in view, the physician should be sufficiently trained in the principles of preventive medicine, hygiene, and sanitation to be of real assistance in the planning and alteration of the store building and store equipment.

2. It should determine the physical fitness of employees, place wisely those who are slightly handicapped, and reject those whose employment would be a menace to themselves or to their fellow employees. To carry this duty properly there must be the closest co-operation with the employment department, coupled with a thorough understanding of the physical requirements of different branches of store work.

3. Recognizing that the chief opportunity for improvement of health lies in disease prevention, particular effort should be bestowed upon the treatment of minor complaints and the detection of incipient disease. Instruction in healthful habits of living should be given by means of personal advice, group health instruction, and articles in store papers.

4. The rare emergencies should be promptly met and the seriously ill directed how best to proceed so that no time may be lost in having proper treatment started. The store physician should place such cases in the hands of the patient's family physician, and he should also possess a list of reliable consultants to whom patients may be sent in the event of particular need.

5. The medical department should aid in determining proper sick benefits.

6. It should develop the records essential to intelligent treatment and, through statistical and graphic methods, should inform the firm what the medical department is accomplishing, at what cost, and with what gain.

In order to meet such duties efficiently, a physician of the highest calibre is essential and it is increasingly evident that the individual who will be most successful is the one who is giving his entire time to group medical work. This does not mean that the small store requires the full time of a physician, but it does mean that the physician employed should do no other work than industrial or store medicine, and that he should have been if possible specially trained for work in this field. His time may readily be divided between several stores but he should not divide it between store medicine and private practice, and, above all else, he should not be permitted to receive fees from store employees for service rendered.

The advantages accruing to the store from the development of such a type of service may in their turn be summarized:

1. The advantage of knowing how much time is lost through illness and accidents.

2. The advantage of reducing the absenteeism, the tardiness, and the inefficiency due to illness.

3. The advantage of constantly improving the healthfulness of conditions of work.

4. The advantage of knowing and causing the employees to know that they are at tasks equal to their physical powers.

5. The advantage of the assurance that when accidents or illnesses do occur, the best medical and nursing care is at once available and that the employee will return to work fit and at the earliest moment consistent with health.

6. The advantage of having good health habits taught in a systematic and effective way thoroughly suited to the needs of groups and individuals.

In order to attain a medical department from which such advantages as these must accrue, it is clear that much attention must be spent upon medical personnel, the executive position of the medical department in the store, the surroundings of the department, and the affiliations of the department with other branches of what used to be known as the "welfare" work of the store, but what is better designated the "service" division of the organization. Selby (*Studies of the Medical and Surgical Care of Industrial Workers*, U.S.P.H.S., Public Health Bulletin No. 99) in a recent report upon medical service in industry speaks of firms with as few as 400 employees using the whole time of a physician. Our examination of the store field leads us to believe that there are few establishments employing 1,000 individuals who will not, after starting medical work upon a sound basis, utilize the full time of one doctor. We have, however, felt that it is unwise to start upon such a basis, and recommend for a store of 1,000 the half time of a single physician who should be paid not less than $2500. The Division of Industrial Hygiene at the Harvard Medical School has made the subject of the salaries of industrial physicians a matter of particular inquiry and is conscious of the fact that there are at present not a few such men who are receiving no more than $2500 for full-time work. The type of man obtained for such a salary as this is almost invariably bad. He takes the work as a filler until he can find something better, or else he is driven to it through persistent failures in other types of medical practice. Neither situation promises benefit to the firm employing him. The store must expect to pay a reasonable initial salary such as we have designated, and must make it clear that if faced with real evidence of gain in efficiency through the existence of the medical department proper increases in salary will be forthcoming.

In selecting a store physician, the following professional and personal qualifications should be kept in mind. By training and temperament the store physician should be fitted to realize that his chief duty is to prevent illness. He should be sufficiently experienced in medical practice to discover the less evident signs of early disease. It is too often our experience to find that cases of tuberculosis or other slowly progressing disease has been discovered far too late for benefit, and after other employees have been exposed to serious danger from infection. He should be a co-operative, broad-minded man, capable of realizing that his success depends upon gaining and retaining the confidence of both the employees and the firm, and he should be able to realize that he will attain these ends not through agreeable talk and bluff, but through furnishing what is obviously the most honest and efficient sort of medical help to all who come to his consulting office.

The store management must realize that the medical department has capacity to render a uniquely useful service and that to accomplish this the physician in charge must be responsible to a member of the firm or to an official high in the work of the store. The man we are discussing possesses initiative and has been through a long

course of training in preparation for his work. It is fatal to place such an individual under the control of subordinate executives who lack the vision to appreciate the powers of development which the store physician's work possesses.

In addition to the physician, the store of 1,000 employees requires two registered nurses, and it is important that these two women have a course in public health work as part of their past experience. One of these nurses will be on duty in the store and the other will have the visiting work to do. Both should be taught that their value to the store rests not only upon their capacity to care for immediate illness, but rests also upon their power to instil quietly and constantly the principles of better health and preventive medicine upon which the entire structure of store medicine must rest. These women should each receive from $1500 to $1800. In addition to their salaries the medical department, if adequately housed, will require $1500 for supplies and miscellaneous expenses, making a total of $7000 for the yearly budget. Circumstances may make it possible to reduce this amount but it is probable that the store will find very early that it pays to increase. Such has been the experience of industry. We know of no case in which industrial medical service has been reduced after once being started, and a large series of cases are available illustrating gradual and wise enlargement after the department has demonstrated its utility.

Finally, a word or two may be written relative to the future work of the Harvard mercantile health group.

1. The medical and hygienic surveys of the stores will be continued.

2. Systematic dental care is a subject of especial study and recommendations for its installation will be forthcoming.

3. The best methods of health education, together with the material to be presented to the employees, need careful organization.

4. More accurate data in regard to causes of disability in store work will be gathered and the material made available.

5. Record keeping will be simplified if possible and standardized so that the health experience of different sections of the country can be made generally useful.

6. A method for furnishing medical service to small stores at reasonable cost and of satisfactory standard is under consideration.

7. Physicians and nurses are being especially trained for store medical work and listed so that stores may be supplied with reliable personnel in their medical departments.

REPORT OF TWO CASES OF DI-METHYL-SULPHATE POISONING *

FERDINAND D. MOHLAU, M.D.
Surgeon in Charge, National Aniline and Chemical Company, Buffalo

DI-METHYL-SULPHATE is an important substance in the newly organized dye industry. The following article is a report of di-methyl-sulphate poisoning in two workmen who were exposed to both the vapor of and the liquid di-methyl-sulphate.

Joseph Schmidt, the first patient, was a man 53 years old, weight 143 pounds, height 5 feet, 8 inches. When he entered the service of this country, the following defects were existent: very bad vision of the left eye (several scars on the cornea), large varicose veins, hernia on the right and left sides, general lymphatic enlargement, and defective teeth. Mr. Schmidt began working for the company April 6, 1920.

The second patient, John Carpenter, was aged 55, weight 185 pounds, height 5 feet, 8 inches. On entering the service of this company, he had the following defects: deficient vision of both eyes, varicocele, hernia of the right side, and defective teeth.

While opening some tanks of di-methyl-sulphate on May 26, 1920, these men, without using the necessary caution, were exposed to this chemical compound. They were not only exposed to the vapor but also to the liquid. With the exception of a slight irritation of their throats and eyes, they felt no effect at closing time and went home. The following symptoms appeared as the evening progressed. The irritation of the eyes became intensified, their throats became more irritated, and the inflammation of the bronchi became progressively worse. The cyanosis, which was just perceptible at first, became aggravated. During the night, Mr. Schmidt felt so ill that he called in a physician who unfortunately did not understand the cause of his disturbance. It was toward afternoon of the next day that we were informed of the man's absence and sickness. Upon visiting him we found the man delirious, with a severe congestion of his throat, symptoms of bronchitis, a severe inflammatory condition of the eyes, intense pain, photophobia and a severe migraine. With difficulty he was persuaded to go to a hospital. Subsequently Mr. Carpenter was visited and found in a similar condition. He also was sent to a hospital, where his condition became worse. He had an acute congestion of both lungs, an edematous condition of the throat and larynx and considerable cyanosis. Mr. Carpenter under proper treatment soon became rational while Mr. Schmidt passed into a comatose state. They both had a chemical pneumonia. Mr. Carpenter had a quick crisis and recovered. Mr. Schmidt, while recovering somewhat, relapsed several times with an aggravation of all symptoms. Eventually both made a recovery yet the condition of their larynges and eyes is still causing a great deal of trouble. Photophobia is still existent. The temperature of the patients at no time was very high, while their pulse rates were fairly rapid; in the case of Mr. Carpenter the pulse was of a peculiar quality. We found that all the mucous membrane of the two respiratory tracts had suffered a very decided corrosive change.

On an examination made July 8, 1920, Dr. F. Park Lewis states that Mr. Schmidt's color vision is practically destroyed, that all he retains is his macular color field.

* Received for publication July 14, 1920.

His field of vision at present is reduced to one-tenth of its normal range. His optic nerve shows pale outer edges but no degenerative changes are discernable.

The following is a report from Dr. Charles A. Bentz, our associate pathologist and bacteriologist, who in conjunction with Dr. R. L. Cameron has experimented with the gas and investigated its pathology on the body.

"About three months ago, Dr. R. L. Cameron, a physician connected with the Miniature Lamp Company, of East Ferry St., corner of Fillmore Ave., brought into my laboratory a rabbit which he had poisoned with di-methyl-sulphate. The Doctor stated that the substance was a liquid, and that he had saturated some cotton with it, and placed it under a bell jar with a rabbit. The animal died shortly afterward. The pathological findings were as follows: On autopsy examination, the blood in the vessels was fluid, and of a dark color. The organs showed intense congestion; the heart muscle was firm, and of good color; the right auricle was distended with blood, the other cavities were not dilated; the cortex of the kidneys was of an indistinct broad structure; the liver was large, pale in color, and mottled.

"Pieces of all the internal organs were preserved in fixing fluids and sectioned. The histological findings showed intense congestion of all the internal organs; the heart showed some parenchymatous degeneration, both in fresh scrapings, and stained sections. Beneath the endocardium the connective tissue showed peculiar mucoid degenerative areas; the kidneys showed acute parenchymatous degeneration; the liver showed intense parenchymatous and fatty degeneration, so marked that it was difficult to find even a few apparently undestroyed liver cells; the lungs showed intense edema.

"Bacteriological examination made of the important tissues and organs was negative, and showed the presence of no bacteria. Spectroscopic examination of the blood gave characteristic bands of methemoglobin. Smears of blood taken from the heart showed an apparently normal count; 8000 white cells (leucocytes), 5,000,000 red cells (erythrocytes). A differential count showed 50 per cent. polymorphonuclears, 48 per cent. lymphocytes, $1\frac{1}{2}$ per cent. eosinophiles, $\frac{1}{2}$ per cent. basophiles. The red cells showed no change in size or shape, nor were there any nucleated forms present. Coagulation of the blood was inhibited. Hemoglobin by Sahli estimation was slightly over 100 per cent.

"In conclusion, it is my opinion that the blood findings show alteration of the red cells by their combination with the poison; that the cell count is normal in number per cubic millimeter, but that there is a relative lymphocytosis present.

"The spectroscopic findings show that there was a combination of the poison with the red blood cells. The tissue changes show the effects of an acute degeneration, characteristic of a volatile poison carried by the blood stream to the various organs, producing the degeneration, the most marked change being in the liver in the form of parenchymatous and fatty degeneration. Just how much the edema of the lungs is due to irritation from the fumes of the di-methyl-sulphate, with the production of edema as a result of irritation, I am unable to state from this one instance. In order to establish that such findings in animals are consistent with di-methyl-sulphate, further experimentation should, I think, be carried out."

In the cases of Carpenter and Schmidt, clinical symptoms showed edema of the lungs; the urinary examinations in single and quantitative amounts showed an increase in the phosphates and sulphates, with a faint trace of albumin, an occasional hyaline cast and no sugar.

These findings, particularly the enormous increase of sulphates, point to liver involvement, and also to intestinal absorption. The clinical findings as well as the pathological changes, comparing the human cases and the experimentally poisoned animals, show consistent changes or lesions.

I am under obligations to Dr. Charles A. Bentz and Dr. Joseph A. Wintermantle for the assistance rendered in the making out of this report.

THE CASE FOR PITHEAD BATHS IN GREAT BRITAIN *

W. E. COSSONS

TO no class of workers is the problem of personal and domestic cleanliness more difficult than to the coal miner, and to the miner's wife. No industrial district is faced to the same extent as the mining area with that complication of its housing problem brought about — as Mr. D. Lleufer Thomas remarks in his introduction to the admirable little handbook on *Pithead and Factory Baths*,† recently published by the Welsh Housing and Development Association — "by the introduction into its streets and homes of an entirely avoidable industrial nuisance in the shape of the dust and dirt from coal which miners, for want of proper facilities at the pithead, carry with them on returning from their work."

The writer goes on to say that the publication of this book marks the launching of a new "offensive" against the twin enemies — Dirt and Disease. The war has brought about a new realisation of the economic value of cleanliness and the recent "Sankey" Commission has focussed a great deal of attention on the conditions under which this dangerous but vitally necessary industry is carried on. A lecture campaign, aided by the cinematograph, is to be carried on in Wales, the largest and most thickly populated mining area in Great Britain, with a view to educating the miner and convincing him of the many advantages of the pithead bath as against the home "tub," on the grounds of health, cleanliness, convenience, comfort, and decency. The nightly "tub" in front of the kitchen fire, used by all the male members of the family, including the sometimes numerous lodgers, was at one time a byword in South Wales. Even now, according to the figures given by the medical officer of health for one of the largest mining districts (Rhondda), out of 26,822 working-class dwellings, 641 (only 2.14 per cent.) possess baths, and of these 550 are occupied by miners.

It is also pointed out that not only is there this lack of domestic washing accommodation, but also an all but complete lack of public baths of any sort.

> Where the need is greatest, there the provision is least adequate. While most of the larger seaport towns and such metallurgical centres as Birmingham or Sheffield, and also those parts of Lancashire and Yorkshire where the textile industries predominate are comparatively well provided with public baths . . . provision is scanty or non-existent in all the mining areas, despite the fact that such areas include some of the most densely populated parts of the country, such as the coal-fields of South Wales, Durham and Scotland.

The *Report on Public Baths and Washhouses in the United Kingdom*, issued by the Carnegie U. K. Trust (1918), states that the total provision in the whole (South Wales) coal-fields, omitting the seaport towns which are outside the mineral area, amounted in 1917 to only four swimming baths, together with a few privately owned "minor facilities." Since then some pithead baths have been added which are described in the book. With municipal baths at only two places and "minor facilities" of a proprietary kind at four or five, it is evident that by far the greater part of the area is left absolutely without any provision at all, and it is probable that an inquiry in other areas would disclose a similar state of affairs.

There is also an entire absence of public

* Received for publication July 20, 1920.

† *Pithead and Factory Baths* by E. L. Chappell and J. A. Lovat Fraser, with introduction by R. Smillie and F. Hodges (President and Secretary, Miners' Federation of Great Britain) and D. Lleufer Thomas (Chairman, Welsh Housing and Development Association). Welsh Housing and Development Association, Cardiff, 2/– net.

wash-houses in colliery districts. Hence the lot of the collier's womankind is made doubly hard — not only has she to provide for his daily bath at home, but she has also to wash his clothes. Well may a visitor stand aghast at the amount of mere cleaning the average woman of a Welsh colliery district has to get through, apart from other domestic duties, and wonder how she does it till he visits the cemetery and observes the ages recorded on the tombstones of the women! In another part of the introduction Messrs. Smillie and Hodges remark, "The miner's occupation will always be hazardous, but that is no reason why his home life should be everlastingly drab or that his wife or mother should be the life-long slave of the pit." It is pointed out, however, that pithead baths cannot be regarded as substitutes for domestic baths, neither, *per contra*, will a bathroom in every house adequately meet the need for the removal of industrial dirt.

There is, notwithstanding the obvious disadvantages of the present arrangements (or rather lack of arrangements), a considerable amount of apathy, if not prejudice, on the question. To quote the Carnegie report, there is found a dislike of "big establishments, and the women will not go long distances, but . . . they will avail themselves of small establishments . . . close at hand." But it is not only among the women, but also among the men that prejudice exists, notwithstanding the fact that the old miner's superstition as to the weakening effect of "washing the back" has nearly died out. Among other objections, there is the fear that having to wait their turn at the pithead bath will delay their getting home to their meals, their allotments, their sporting dogs or the inevitable "pictures."

These disabilities act and react on each other; inadequate housing, with its lack of privacy and convenience, inevitably results in a low standard of cleanliness and morality and, furthermore, of health, leading to excessive infantile mortality. There are hopes, however, for the future. The increasing interest of the younger generation of miners in athletics and physical culture, the mere economy of coal in heating the pithead bath, as against the supplying of coal at a nominal figure to each collier's home, the rising standard of comfort and self-respect, possibly also the newly-won voting power of women, will all have their effect.

One point, which may have been overlooked, to which Mr. Thomas draws attention, is that of the psychological effect on the collier class of facilities for cleanliness.

> . . . The social advantages . . . far transcend the merely utilitarian. . . . If in the streets and public conveyances, workmen, on returning from work in dirty clothes and with blackened faces, habitually meet other people with clean exteriors, consciousness of their own outward condition is bound to react injuriously on their minds and character. Their self-respect, especially if they form a minority of the population, is bound to be undermined and they are less likely to have a due regard for the decencies and courtesies of life. They are apt to believe that other people look down on them as if they belonged to a Helot class. . . . On the other hand, if they are in a majority, their wounded self-respect may occasionally lead them to over-assert themselves at the expense of other sections of the community. . . . I wish to suggest for serious consideration whether the "colour-bar" of the mining industry is not largely responsible for that spirit of sectionalism and of clannish trade-consciousness which seems to exist among the miners in a greater degree than among other workers. . . . This is something different from the ordinary class-consciousness of the working-class Socialist. . . .

The first portion of the book deals in detail with the points raised in the introduction to which we have referred. It draws attention to such points as the effect of the lack of accommodation for changing garments when the miner has, as is frequently the case, a long walk to work in bad weather, with perhaps a railway journey in a draughty carriage as well. He toils in a

high temperature, frequently in a wet working place, then turns out into the world again, to meet the greatest contrast of temperature. The figures quoted in *Dangerous Trades* (Oliver, 1902) show that, while 14.5 per cent. of the total deaths of miners are due to accident, no less than 40 per cent. are due to phthisis, pneumonia, and bronchitis. In addition, there is an enormous amount of illness due to rheumatism, sciatica and lumbago. As to home conditions, the authors give some startling figures which emphasize the points already alluded to. The following are striking:

Midlothian and Linlithgow (1912)

(Houses provided by mine owners for their employees.)

One room	11 per cent.
Two rooms	65 per cent.
Three or more	24 per cent.

(Bathrooms practically non-existent)

Stirling and Dumbarton (1908)

Number of miners	12,276
Average per house	1.65

An investigation in a number of typical colliery villages gave the following figures:

Number of miners' houses	2,266	
Average number of persons per house	5.59	
One-room houses	2.50	per cent.*
Two-room houses	84.2	per cent.*
Three-room houses	11.5	per cent.*
Four-room houses	1.8	per cent.*

The following are figures of the pre-bye-law era and date from the early nineteenth century or earlier.

Number of Houses	1643
One room	25.80 per cent.
Two rooms	71.51 per cent.
Three rooms	1.95 per cent.
Four rooms	0.67 per cent.
More than four	0.06 per cent.

Only forty-five of these had an inside water supply and there was none with a bath.

* These figures refer to houses built under the bye-laws and are the most modern in the counties. The four-roomed houses are not necessarily occupied by miners.

Dr. McVail, who is responsible for these figures, alluding to the deficiencies of the water supply, speaks of the large sums paid weekly by colliers' families for mineral waters for drinking purposes, and of a collier who even washed his face in soda water. Conditions in this particular respect, however, are now altered, though many Scottish villages still have a very deficient water supply and that very often of such a nature as to lead to outbreaks of enteric fever.

The figures for the Northumberland and Durham districts of England are equally striking, the percentages for overcrowding, as compared with 9.1 for England and Wales, ranging as high as 43.6. In the West Riding of Yorkshire, according to evidence given before the Coal Industry Commission of 1919, there were 2,793 families living in one-roomed houses and 31,908 in two rooms. Where such conditions exist it is not to be wondered at if uncleanliness is sometimes chosen as the lesser of two evils.

As far as the position affects women, the issue is frequently complicated by the fact that the men work in different shifts, arriving home at different hours. The miner's day is seven hours; the woman's, seventeen (or more). Medical men and others speak of the ill-effect on mothers and children of the strain of lifting heavy tubs, while a South Wales coroner remarks, "I have no hesitation in saying that hundreds of children have lost their lives during the last ten years through scalds at home. . . . Every winter I hold more inquests on miner's children who die from scalds or burns than I do on miners killed underground."

Summing up the advantages of the colliery bath, we may say that it would (1) improve the health, comfort, safety and moral purity of the miner and his family; (2) increase his efficiency, effect economies, and improve conditions of safety; (3) give

greater comfort to other members of the public who use the same conveyances as the miner; (4) increase the miner's self-respect and add to his status. With regard to the second group of advantages, we may note that the dislike of working in damp clothes is a prolific cause of absenteeism, and that when a man descends the pit in the garments he wears on the surface, he often inadvertently takes down matches which have secreted themselves in folds and creases of pockets and linings.

Chapter II deals with the history of the movement in favor of pithead baths in Great Britain. The metalliferous mines seem to have taken the lead in this respect; even in the thirties, some of the Cornish concerns had certain facilities, and today many of the owners have made provisions generously in excess of the minimum requirements of the law (Metalliferous Mines Regulation Act, 1872, Sec. 32, Rule 16). Further recommendations were made by a commission in 1914 but have not yet been put on the statute book. It is remarked, however, that such provision is not fully appreciated and there is no general demand by the workers for improved facilities.

In respect to coal mines, although some collieries had made experiments, it was not till 1911 that legislation was passed on the subject, and the first model scheme in this country was initiated in 1913 by Messrs. Fletcher, Burrows and Co., Ltd., of Atherton, Lancashire. Where previous experiments had been carried out, it was too often found that the facilities provided were not taken advantage of and in many cases the buildings were ultimately used for other purposes. The Coal Mines Commission of 1906–1909 recommended that the question of the provision of pithead accommodation should be determined by the attitude of the workers themselves. Basing their calculations on figures obtained in Germany, they said the cost of installation should work out at about 2*d*. per man employed, of which possibly the men should pay half. The commission did not, however, recommend that the use of such accommodation should be made compulsory, and, furthermore, insisted that action should be taken in the first place by the miners. Some of the miners' leaders, however, who sat on this commission were strongly of opinion that use of the pithead facilities should be made compulsory. When it was sought to give legislative sanction to these proposals — and the government included a section for making the provision compulsory — it was seen that there was strong objection from a considerable body of miners to being *compelled* to use the baths, the strongest objection coming from Durham, where conditions certainly do not compare favorably with other districts, bad as the other districts are. Though a resolution was carried in the face of this opposition and the Miners' Federation issued a strongly worded appeal in favor of retaining the compulsory clause, the general body of miners still remained unconverted, while the owners "of course objected to being compelled to undertake capital expenditure which did not produce additional revenue." The clause was therefore abandoned, and the Majority Report recommendations inserted, providing that where two-thirds of the employees desire accommodation and are prepared to pay half the cost of maintenance, the owners shall make provision for baths and clothes drying. After this act (1911) was passed, propaganda was carried out — very largely by the Women's Labour League — and in 1913 Mr. David Davies, M.P., Chairman of Directors of the Ocean Coal Co., Ltd., a very large concern, besides setting up a model installation at one of the largest of the firms' pits, sent a deputation of miners at his own expense to inspect various continental installations. The report of the Coal Industry Commission of 1919 gave further impetus to the movement.

The authors then go on to describe pit-head washing and drying installations in various countries. Germany was the pioneer but, though most carefully arranged from a hygienic point of view, the lack of privacy characteristic of the German arrangements does not commend them to the British worker. Separate accommodation is provided, however, for boys of 18. Another objection to the German system is the waste of water as a whole section of sprays is controlled by one valve; thus, if only one man is bathing, the whole section is in action. The men are required to take home their dirty clothes every week-end and the whole place is thoroughly cleaned. The pre-war cost is estimated at $2\frac{1}{4}d.$ per man per week. In Belgium, bathing accommodation was provided — in some cases, of necessity, to retain the workmen — before it was made compulsory. The decree of 1913 made the provision of baths compulsory where the largest shift was not less than fifty men, and included minute details for the construction of the buildings, baths, clothes-storing and drying facilities. The shower-baths insisted on were enclosed in cabinets, ensuring a high degree of privacy. Use was not made compulsory on the men, and was gratuitous, but they had to provide their own soap and towels. Where less than fifty men formed the largest shift, wash basins and clothes rooms had to be provided. In France, accommodation varies greatly, but it was on a French model that the British Home Office based their regulations — the simple and inexpensive installation at Lens (No. 5) Colliery, Pas de Calais, of which a lengthy description, with diagrams, is given in the book. A great feature of this system is that each cubicle is divided into a "wet" and a "dry" compartment. The miner partially undresses in the common room, then enters the outer half of the cubicle where he divests himself of his other garments, and after he has had his bath (a shower controlled by the individual user) in the inner compartment, he returns to the "dry" half and puts on a portion of his clean clothes, which he has taken with him, completing his toilet in the common room.

Here one may point out the superiority of the suspended bag (with a lock, the key of which is in possession of the individual) for storing clothes kept at the mine, over the iron locker which is a feature of some systems. The drying of the clothes in lockers by steam pipes makes the building stuffy; the locker must be perforated, allowing dirt to get through. In some of the American installations two sets of lockers are provided, in different parts of the building, for working clothes and for clean clothes. In others, each locker is in two parts, the upper compartment for mine clothes, with steam pipes and fan for drying. In others, again, lockers are provided for street clothes only, a special drying rack, with coils of steam pipe below and a galvanised iron hood above, being used for the mine clothes. The law, as to provision and compulsory use, varies in the different states, and it is notable that some of the finest installations are to be found where no legal compulsion exists. The Bureau of Mines reported in 1914 that an average of 85 per cent. of the men employed in the mines investigated used the baths. In a large number of cases, a fee of from 50 cents to a dollar per month was paid by them. In New Zealand mines employing over fifty men, a request from thirty of them is sufficient to secure the obligatory provision of baths, but mine owners are not compelled to provide for more than one-third of the men employed, with the result that many of them prefer to go home rather than "wait in the queue."

After reviewing various British model systems, the authors proceed to discuss the demand for new legislation on the question. The underlying principles of Section 77 of the Coal Mines Act, 1911 are:

1. The onus of demanding accommodation is on the workmen, but, as the authors point out, the majority of men do not ask for what they do not see or understand, especially if a change of personal habits is involved. It may be noted here, as a writer in the *Daily News* (London) recently said, that a great many of the objections raised to the colliery bath come from the individual who benefits not least from it — the miner's wife. She holds a "proprietary" interest in her men folk and among other things fears they will catch cold if they turn out from a warm bath into a winter's night.

2. Employers are obliged to provide baths subject to certain conditions. Here the objection is that if the estimated cost of maintenance is more than 3*d*. per man per week, although an overwhelming majority of the miners may be in favor, the employer is not compelled to provide baths. As at present an installation cannot be put in for less than £1600 for 500 men, it will be seen that compulsion under this section is impossible.

3. The cost of maintenance is to be shared equally between employers and workmen. It is now contended by the Miners' Federation that the cost of removing industrial dirt should be a charge against the industry.

The authors then outline proposed new legislation starting *de novo*. They recommend that bathing facilities should be obligatory at all collieries (with certain special exceptions to be made after the strictest inquiry); that the cost of provision and maintenance should be charged entirely against the industry; that use by the men should be optional and that the management should be vested in a joint committee of workers and employers.

Space does not permit of further details, but, in concluding this brief summary of the book, it may be noted that a lengthy chapter is devoted to the answering of objections to the pithead bath system and one to the question of baths at works and factories other than mines. Specimen rules for management, detailed figures as to costs, are also given and the book is fully illustrated with photographs and diagrams.

OBSERVATIONS ON THE TOXICITY OF TETRANITROMETHYLANILINE (TETRYL), TETRANITROXYLENE (T.N.X.), TETRANITRANILINE (T.N.A.), DINITRODICHLORBENZENE (PARAZOL), AND METANITRANILINE *

H. GIDEON WELLS, M.D.
Director, Otho S. A. Sprague Memorial Institute

IN COLLABORATION WITH

JULIAN H. LEWIS, W. D. SANSUM, W. B. McCLURE AND H. O. LUSSKY
(*From the Otho S. A. Sprague Memorial Institute, Chicago*)

During the war several problems concerning the toxicity of various explosives or chemicals, used in munitions plants, were referred to the Otho S. A. Sprague Memorial Institute for investigation. The sudden cessation of munitions work terminated these investigations, most of them while incomplete. Some definite observations having been made, it has seemed desirable to make them available, and hence the following synopsis of some of our results is published. As they do not represent work carried to completion, the numerous protocols and much negative and inconclusive work are not presented. Numerous members of the Institute have collaborated in this work, as indicated in the text.

1. Toxicity of Tetranitromethylaniline (Tetryl), Tetranitroxylene (T.N.X.), and Tetranitraniline (T.N.A.)

Drs. W. D. Sansum and Julian H. Lewis administered these substances to dogs and rabbits in doses of grams per kilo of body weight and thereby ascertained their lethal dose, the clinical symptoms they produced, and, on autopsy, their pathological effects. The majority of the tests were made with subcutaneous injections of emulsions in olive oil. Attempts were made to give repeated small doses to dogs by stomach tube, but this method produced vomiting even when the substances were given in milk. Repeated small doses given to rabbits by stomach tube were less toxic than those given by the subcutaneous method. Daily inunctions with tetryl, the most toxic of the group, were made over long periods of time in dogs with no fatal results. A dermatitis soon developed in these cases, but no anemia or other blood changes resulted. In general, these substances were found to be relatively non-toxic, which may be partly explained by their relative insolubility.

Tetryl

The smallest fatal dose was 0.5 gm. per kilogram of recrystallized tetryl given to a dog subcutaneously in olive oil as five daily doses of 0.1 gm. per kilogram each. The dog lived fifteen days. Autopsy showed grossly a mild nephritis. Usually the organs showed no distinct gross pathological changes. The largest non-fatal dose was 2.5 gm. per kilo given subcutaneously as a single dose in olive oil. Five grams per kilo killed in less than eighteen hours. With these large doses much of the tetryl was unabsorbed. Rabbits given 1 gm. per kilogram of body weight by stomach tube in milk were killed after one to three doses. The same amounts given subcutaneously in olive oil were sometimes but not always fatal after six to ten doses.

Microscopically the tissues of rabbits and dogs after fatal doses of tetryl showed at

* This work was conducted under the auspices of the National Research Council. Received for publication June 23, 1920.

the site of injection a severe acute inflammation, with more or less edema and hemorrhage and sometimes waxy degeneration of muscles lying in the injected material. Without exception the kidneys showed toxic degenerations, so that in animals dying after a few days the epithelium was intensely swollen, with resulting albuminuria; usually there was much protein in the tubules and glomerular spaces, but little tendency to form casts. In one dog, dying within eighteen hours of the time of injection of 5 gm. of tetryl per kilo, the glomerular capillaries were distended with agglutination thrombi of fused red cells. In some cases there were areas of necrosis in the convoluted tubules. Fat granules were frequently found in the epithelium of the ascending loops of Henle in dogs, usually in moderate amounts, with little or no fat elsewhere. In rabbits the fatty changes were not found, although swelling and degeneration of the epithelium was marked.

The liver, in several dogs, showed marked changes, consisting of varying degrees of necrosis in the centers of the lobules and usually severe fatty degeneration of the liver cells, and also a noticeable deposition of fat in the bile duct epithelium. The rabbit livers showed almost no changes. Several of the animals showed more or less edema in the lungs and bronchi, in one case thrombi being observed in the pulmonary artery.

The spleens often showed blood pigment in moderate amounts, but without the congestion usually observed with hemolytic poisons. No noteworthy changes were observed in the other viscera.

Tetranitroxylene

The smallest fatal dose by subcutaneous injection was 1.2 gm. per kilo given to a dog as twelve daily doses of 0.1 gm. per kilo. The dog lived twelve days. The urine contained albumin and the kidneys showed a parenchymatous swelling. A rabbit receiving 1 gm. per kilo intraperitoneally died during the night, with much ascites. The largest non-fatal dose was 5 gm. per kilo given to a rabbit as a single dose subcutaneously in olive oil. No larger doses were given. The meta and para T.N.X. seemed to have the same toxicity. T.N.X. had no effect on the blood count. Goldfish were killed in fifteen minutes in a 1:100,000 solution of T.N.X., while they lived indefinitely in a 1:1,000,000 solution.

Microscopically the effects of T.N.X. were seen chiefly in the kidneys, in both dogs and rabbits the epithelium of the convoluted tubules showing more or less vacuolization, but no cast formation. A dog that received ten daily doses of 1 gm. each showed considerable calcification of necrotic tubular epithelium, similar to that seen in mercuric chloride poisoning. There was no excessive pigmentation of the spleen or other evidence of hemolysis. A rabbit that had four daily doses, each of 1 gm. per kilo subcutaneously, showed several areas of focal necrosis in the liver. A rabbit that received nine doses of 1 gm. per kilo by mouth in capsules showed only a fatty degeneration of the epithelium of the collecting tubules of the kidney and no other changes, indicating that little of the T.N.X. was absorbed. Two dogs, given each 5 gm. per kilogram in one dose subcutaneously and dying within eighteen hours, showed extreme fatty degeneration of the ascending limb of Henle's loops, but no other changes. In a few instances a slight fatty degeneration was observed in the center of the liver lobules.

Tetranitraniline

The smallest fatal dose was 2.5 gm. per kilogram given to a dog subcutaneously as a single dose in olive oil. The dog lived six days. The largest non-fatal dose was 5 gm. per kilo given to a dog as above. No larger doses were given. Rubbed on the skin as an

ointment, T.N.A. produced a dermatitis, and apparently some of it was absorbed, because of the effect produced on the urine. T.N.A. had no effect on the blood counts. Goldfish were able to survive in a 1:12,000 dilution of T.N.A. for at least two weeks.

Microscopically the effects of T.N.A. were as follows: At the point of injection of T.N.A. in oil there occurred a marked acute inflammatory reaction without suppuration. At times we have seen dark yellow masses of the material that have infiltrated ducts of the mammary gland and led to a striking epithelial proliferation, recalling the effects observed when oil solutions of Sudan III and Scarlet R are injected into epithelial tissues. Ordinarily the viscera showed no important gross or microscopic changes in dogs or rabbits given even large or repeated doses of T.N.A. The urine occasionally showed a little albumin, but not usually, and the renal changes were insignificant.

2. The Action of Parazol (Dinitrodichlorbenzene) on the Skin, and Substances Which Will Prevent It

The experiments were conducted by Dr. W. B. McClure and Dr. H. O. Lussky.

Parazol melts at 60°. The pungent odor of the crude substance becomes more marked as the temperature is raised. At about 125°C. dense white fumes are produced and they become more dense as the temperature increases. These fumes are heavier than air and have a pungent penetrating odor. Crude parazol applied to the shaved skin of a rabbit produces hyperemia, edema, and at times necrosis, the degree varying with the duration of application. (The experiments extended up to two hours only.) On removing the parazol at the end of the application there is redness and edema extending well beyond the area of direct contact. This redness and edema usually reach their maximum of extent in area and degree at the end of six hours, and have usually subsided considerably at the end of twenty-four hours. The edema next disappears entirely, and finally after about four to six days there is a superficial desquamation, and then complete disappearance of the lesion. Occasionally superficial necrosis occurs. Linseed oil or water added to parazol causes no different reaction. The sublimate obtained by cooling the fumes arising on heating parazol to 80° are apparently slightly less active than parazol. In lanolin, parazol seems less active. Melted parazol has about the same toxicity as crude parazol, while purified parazol is distinctly less toxic than crude parazol. Mice lived in cages over crude parazol, apparently without harm. When exposed to fumes from heated parazol they gave evidence of marked skin irritation, but three-minute exposures were not fatal.

Crude parazol applied to the skin of man has the following course of action. Up to one hour application, no reaction occurred. Application for two hours produced hyperemia, finally a small vesicle. Application for three hours and fifteen minutes caused an itching at about three hours. A red slightly raised lesion, larger than the area of contact of parazol, was present on removal of the preparation; the edema increased somewhat during the next seven hours. After twenty-four hours the lesion was denuded superficially and tender to the touch. No extension of the area occurred. After forty-eight hours a flabby blister containing a clear fluid replaced the red lesion. After four days the vesicle collapsed and the edges were somewhat raised. After six days there was a red-brown scab. On the seventh day appeared what was probably a secondary dermatitis, manifested by secondary vesicles and hyperemia about the lesion, and marked itching. This gradually subsided and scaling resulted in final healing after about seven more days, only a small brown-red discoloration persisting.

Fumes from parazol heated to 80° and applied to rabbit's skin for five to fifteen minutes produced only a mild reaction (hyperemia and very superficial scaling with little or no edema). The fumes produced by heating to 150° and applied to rabbit's skin for five minutes produced a reaction definitely greater than fumes from the 80° heating. The white fumes produced by heating over a free flame and applied to the skin for one to eight minutes produced a much more marked reaction than the other applications.

Rabbit's shaved skin is protected against crude parazol by the following (given about in decreasing order of degree of protective power):

1. Sample C (1)
2. Sample A (2)
   Material Z (3)
   Material Z II (4)
   Material IV (5)
   Cloth III (6)

   (Items 1–2 above: All having G.A.G. (12))
3. Oil silk (7)
   Water-proof horsehide (8)
   Oil cloth (9)
   Adhesive plaster (10)
   Split leather (11)
   Glove leather (ordinary dress glove leather)
4. Rubber was a poor protective

1. Sample C = Water-proof cloth. Two layers with 5 layers of G.A.G.
2. Sample A = Same as Sample C but with 2 layers of G.A.G.
3. Material Z = Muslin impregnated with G.A.G. and hardened with chrome salts.
4. Material Z II = Muslin impregnated with G.A.G. three times, then hardened with chrome salts.
5. Material IV = Muslin impregnated with G.A.G. three times.
6. Cloth III = Water-proof paper with 2 layers of G.A.G.
7. Oil silk = Bauer and Black.
8. Water-proof horsehide = Pfeister and Vogel Leather Co., Milwaukee.
9. Oil cloth = Cheap grade.
10. Adhesive plaster = Lewis Manufacturing Co., Walpole, Mass.
11. Split leather = Pfeister and Vogel Leather Co.
12. G.A.G. = (Helmholz and Lussky) glycerol, 50; acacia, 50; glue, 50; water, 200 parts.

3. Toxicity of Metanitraniline. Its Quantitative Determination in the Urine

These experiments were performed by Dr. Julian H. Lewis.

Metanitraniline is a yellow, light, fluffy, odorless powder. The sample used for experiments had a melting point of 111.5° (114° Beilstein). It is soluble in the organic solvents and slightly soluble in water. It forms a 3.5 per cent. solution when saturated in olive oil. The dry powder is rather volatile, as is shown by the fact that a filter paper covering a dish of the dry substance is colored yellow over night at room temperature. It is toxic for experimental animals, but not markedly so. Its toxicity for the various animals used stands in the following descending order: dog, cat, guinea pig, rabbit. A 6.3 kg. dog was killed in four hours by an intraperitoneal injection of 15 c.c. of a 3.5 per cent. solution in olive oil, or 0.07 gm. per kilo. The average sized rabbit (1.7–2 kg.) will stand an intraperitoneal injection of 15 c.c. of the 3.5 per cent. solution (0.2–0.25 gm. per kilo), without any marked toxic effects, but 20 c.c. usually kills and 30 c.c. always kills. One rabbit (1.9 kg.) received eleven daily injections of 10 c.c. of 3.5 per cent. M.N.A. subcutaneously without serious effects. A 2025 gm. cat was killed with 15 c.c. of the 3.5 per cent. solution given intraperitoneally. A 970 gm. guinea pig was killed with 7 c.c.

Death in all of the animals was acute and was manifested by dyspnea and convulsions. The autopsies of these animals showed the signs of asphyxia. The blood was of a dark color and did not coagulate readily. Methemoglobin was not found in the blood

on spectroscopic examination. Rabbits given repeated sublethal doses rapidly developed a profound emaciation and a blood examination of these animals showed a severe secondary anemia. For example, a rabbit was given subcutaneously 15 c.c. of 3.5 per cent. solution of M.N.A. in oil on December 1. Before the injection the red count was 6,560,000; white cells, 8,560, with 58.5 per cent. polymorphonuclears, 33.3 per cent. small mononuclears and 8.2 per cent. large lymphocytes. On December 3, the counts were: red cells, 3,792,000; white cells, 14,600, with polymorphonuclears 55.9 per cent., small mononuclears 27.1 per cent., large lymphocytes 12.3 per cent., unknown cells 4.7 per cent. The injection was repeated December 3, and on December 8, the red count was 1,548,000, with 6,233 white cells which included so many atypical forms that a differential count could not be made. On autopsy the changes of the bone marrow characteristic of anemia were found. The kidneys and spleen were usually swollen and very dark in color.

Microscopically the anatomical changes produced by M.N.A. were far more marked than those resulting from T.N.A., T.N.X. or tetryl. In animals living a few days there occurred a profound hemolysis and the changes found in the tissues seemed to depend on this hemolysis. The renal tubules were distended with masses of hemoglobin, either as small globules or fused into casts, which sometimes seemed to occlude nearly all the collecting tubules. The tubular epithelium was usually relatively unaffected, at most showing swelling or vacuolization, with little or no necrosis. In some the glomerules showed little or no change; in others the tufts were compressed by a protein exudate which did not seem to contain hemoglobin. No hemorrhage or inflammatory changes were observed. There was usually fatty degeneration of the epithelium of the straight tubules, especially in Henle's loops, in rabbits as well as in dogs.

In several cases there occurred more or less necrosis of the liver cells in the centers of the lobules, occasionally marked, and there was usually central fatty degeneration of varying degree. Fatty degeneration of the myocardium was sometimes found.

The spleen was distended with red corpuscles in acute cases, and contained much blood pigment in animals living longer. Often the blood in the vessels of preserved sections showed extensive hemolysis, presumably postmortem. Leucocytosis was often conspicuous.

The vessels of the lungs usually, and less often of the liver and other viscera, showed thrombi, sometimes of fibrin and sometimes apparently of agglutinated erythrocytes. This probably accounts for the varying degrees of pulmonary edema and distention of the right heart that were commonly observed, and for the sudden death with dyspnea and convulsions.

The urine of animals injected with toxic doses of metanitraniline showed marked and constant changes. It was of a dark reddish-brown color. It contained a trace of albumin and sometimes a few red cells; however, no hemoglobin was demonstrable with the guaiac test or spectroscopically. Methemoglobin was not present. This condition lasted about three days and the urine finally became normal. A second injection of metanitraniline always produced much less change than the first injection. In fatal cases there developed anuria, probably from occlusion of the tubules by hemoglobin casts.

Metanitraniline could always be demonstrated in the urine after injection, both in the free form and conjugated. To illustrate this, a sample of urine without previous treatment was extracted with ether. The ether was colored yellow. The extraction was continued until the ether was no longer colored. The urine was then mixed with an

equal volume of 40 per cent. sulphuric acid, allowed to stand one-half hour, and then neutralized with 20 per cent. sodium hydroxide. On repeating the extraction with ether it was again colored yellow. The extraction was continued until complete. The ether from both extractions was evaporated to dryness. Pure crystals of metanitraniline, determined by their melting point, separated on the sides of the vessels.

Dr. M. Th. Hanke devised a colorimetric method for estimating metanitraniline, which was based on the method of determining nitrates with paraphenylenediamine. Metanitraniline in a weak alcoholic solution is reduced to paraphenylenediamine with zinc dust and sulphuric acid. When mixed with sodium nitrate, paraphenylenediamine gives a brown color (Bismarck brown) which can be estimated colorimetrically. Table 1 gives the results of determinations of metanitraniline in the urine of animals after the injection of this substance. Plans to examine the urine of workers in metanitraniline factories to see if metanitraniline could be demonstrated by this method were frustrated by the cessation of war.

TABLE 1. — DETERMINATIONS OF METANITRANILINE IN THE URINE OF ANIMALS

Animal	Weight	Dose of Metanitraniline	Volume of Urine	Amount of Metanitraniline in Urine, Colorimetric Determination
Rabbit	1870 gm.	0.53 gm.	1st day, 100 c.c.	= 0.0675 gm.
			2d day, 110 c.c.	= 0.0053 gm.
			3d day, 17 c.c.	= 0.0 Total, 0.0728 gm.
Rabbit	2130 gm.	0.53 gm.	1st & 2d day, 79 c.c.	= 0.0775 gm.
			3d day, 70 c.c.	= 0.0 Total, 0.0775 gm.
Rabbit	1940 gm.	0.53 gm.	1st day, 85 c.c.	= 0.0612 gm.
			2d day, 94 c.c.	= 0.0213 gm.
			3d day, 109 c.c.	= 0.0 Total, 0.0825 gm.
Dog	10.5 kg.	1.05 gm.	Died in 3 hrs., 150 c.c.	= 0.00087 gm.
Dog	6.8 kg.	0.53 gm.	Died in 4 hrs., 1st hour's urine	= 0.00016 gm.

THE PLACE OF INDUSTRIAL MEDICINE IN MEDICAL SCIENCE *

FRANK SHUFFLEBOTHAM, M.A., M.D. (Cantab.), M.R.C.P. (London)

NO branch of medical science has been so much neglected in the medical schools of our country as industrial medicine and, in view of the reorganization not only of medical teaching but of industries generally, it is necessary that attention should be paid to this important subject. It is now realized that the health of the people is one of the principal assets of the nation and if the production of commodities and manufactures in industrial countries are to be increased, the health of the worker must be maintained at the highest possible level. This condition can only be brought about by a proper understanding of the conditions of labour in the various industries and of the dangers to which the workers are exposed as a result of their employment.

Each industry has its own problems and in the large cities where several industries may be centred it is essential for medical men who practice in such districts to have special knowledge of many industrial diseases. For instance, in North Staffordshire we have, in addition to the pottery industry, coal and iron mines, blast furnaces, steel works, chemical factories, by-product and coking plants as well as brick and tile works, so that a medical man in practice in this district should be conversant with such conditions as lead poisoning, silicosis of the lung, miners' nystagmus, beat hand, beat knee, beat elbow, poisoning by carbon monoxide and other gases, chrome ulceration, eczematous ulceration of the skin, etc., and he should be able to detect ankylostomiasis should this disease arise. In Lancashire, Yorkshire, the Tyne District, South Wales and many other great industrial centres where multiple industries are carried on, medical problems of an equally wide range are involved.

The Workmen's Compensation Act applies to nearly thirty different industrial diseases and their allied conditions, and in view of the numerous cases which arise year by year throughout the whole of the country, it is indicated that these diseases are widespread.

Let us consider for one moment the coal mining industry. In Great Britain alone more than a million men and boys are employed in this industry and each year during the last ten years there have been on the average 1300 fatal accidents resulting from employment in the mine. In addition to these fatal accidents, there are more than 160,000 non-fatal accidents occurring each year. As the result of the same employment and in spite of legislation, there has practically been no reduction in the number of fatal and non-fatal accidents in the mines of Great Britain during the last twenty years. I would point out that these 160,000 cases are non-fatal cases but do not include accidents of a trivial nature where no weekly compensation is paid; that, roughly speaking, during each year 55,000 miners are injured so seriously as to become incapacitated for work for between one and two months; and that at the end of each year there are 12,000 miners who have not recovered and who are totally incapacitated for work. Moreover, as I have said on previous occasions, it should be clearly understood that accidents in the case of a miner do not mean simply broken limbs or sprained backs but may be the cause of injuries which set up a sequela of symptoms. Diseases of a very serious nature may arise or may be intensified as a result of the original accident.

* An address given at the Industrial Hygiene Section of the International Public Health Congress held at Brussels on May 21, 1920. Received for publication June 21, 1920.

With regard to the disease known as miners' nystagmus, which is the commonest occupational disease known to medical science, Dr. Llewellyn has pointed out many times that this disease again is at a standstill. The cause is known, but nothing has been done effectively to prevent the onset of this protracted disease. The Home Office Statistics of Compensation for Great Britain during the year 1914 show that in that year 2,775 miners were totally incapacitated for work on account of this disease, and that 3,218 coal miners were suffering from it during that year, although their cases had been reported in previous years, so that the total number of miners receiving compensation during 1914 was approximately 6,000. When it is remembered that miners' nystagmus is a disease which takes from ten to twenty years to mature before complete incapacity for work is produced and that there are thousands of miners in this country who have received a lump sum settlement and who are employed in other ways, it is easily conceived that thousands of workers are affected by the condition. I have already said that practically nothing has been done to reduce the incidence of miners' nystagmus and that when a man has contracted the disease and is totally incapacitated for work there is practically no treatment for him beyond leaving the employment in which he has been engaged all his life.

After miners' nystagmus, the group of diseases (also concerning miners) known as beat hand, beat knee, beat elbow and inflammation of the synovial lining of the wrist joint and tendon sheaths constitutes the next largest group of industrial diseases which we know in this country; and I would point out that, of the total number of cases for which compensation is paid, the mining industry absorbs between 85 per cent. and 90 per cent. In 1914 there were 817 fresh cases of beat hand, 1609 new cases of beat knee and 346 cases of the other conditions, making a total of 2,772 cases, in addition to which there were a considerable number of cases reported in the previous year which had not been cured. Although so many cases of these conditions arise year by year there is practically no mention of them in the text books, and so much confusion exists as to the pathology of these conditions that even in the third schedule to the Workmen's Compensation Act in which they are included, while beat hand and beat knee are referred to as forms of subcutaneous cellulitis, beat elbow is described as bursitis of the elbow. As a matter of fact, beat hand, beat knee and beat elbow are identical from a pathological point of view.

If one views the medical aspect of the coal mining industry alone and recalls that there has been practically no improvement, at all events as regards the number of accidents occurring and the number of industrial diseases arising, there is almost virgin soil for the medical profession to work on, not only with a view of reducing the number of accidents but also of diminishing the number of cases of industrial disease; and, further, when one considers how diseases may be set up by accident or aggravated by an injury there are infinite possibilities for research in this direction.

It is, in my opinion, essential that medical men trained in the great medical schools of industrial countries such as England, Belgium, France and the United States should receive training with regard to the conditions under which men and women work in the various industrial districts. An intimate knowledge of industrial diseases is absolutely essential to the medical practitioner if he is to detect disease early and to prescribe the best treatment. Further, it is equally advisable on the ground that in the case of many industrial diseases it may be necessary for the affected workman to change his employment as soon as symptoms arise. This point spe-

cially applies to cases of miners' nystagmus and lead poisoning.

There is practically no provision for the teaching of industrial diseases in the medical schools of this country (Great Britain). It therefore follows that young medical men commence practice with no knowledge of these diseases and are obliged to obtain their experience at the expense of the patient. In this way it can easily be understood that cases of industrial diseases may not be diagnosed until it is too late and the patient may become a chronic invalid and his working days be at an end. In the interests of the state all medical referees under the Workmen's Compensation Act and all certifying factory surgeons should be familiar with the various phases of industrial conditions before they commence their duties.

From these remarks it is obvious that provision should be made for the teaching of industrial medicine in suitable centres so that experience can be gained prior to commencing practice. Further, in view of the importance of the subject and the widespread incidence of these diseases, I recommend that it be a compulsory subject for the examination for the Diploma of Public Health and that no medical practitioner be qualified for the position of medical referee under the Workmen's Compensation Act or certifying factory surgeon unless he has attended a recognized course of lectures or demonstrations on this subject.

POINTS IN THE DETECTION OF INDUSTRIAL FATIGUE AND MEASURES FOR ITS POSSIBLE COMPLETE ELIMINATION*

EMERY R. HAYHURST, Ph.D., M.D.
Professor of Hygiene, Ohio State University

THE major use of fatigue studies is their application to industry. It is because disease is associated so closely with fatigue that such studies have from the first had a closer relationship with medicine than with industry.

Fatigue in industry is a matter of extensive economic importance. In all countries, including the United States, the effect of the recent eight-hour day program has not by any means removed the fatigue hazard from industry, for the shorter workday applies to a relatively small proportion of the total number employed. It also applies to a considerable number, like railroad workers, whose working day is interspersed with many rest intervals. Even in the eight-hour day, vast numbers of people are employed for four straight hours at a spell under strain or in repetitive and very monotonous tasks. Nevertheless, there is no question but that the basic eight-hour day has laid the foundation for greater control of industrial fatigue.

Fatigue control in industry is at present a very haphazard affair depending largely upon the policies of employers who are checkmated by the responses of labor. Obviously this is quite unscientific and wasteful. The greatest advance in the control of industrial fatigue has come through the Frederick Winslow Taylor system of so-called "scientific management." In total, however, this applies to a relatively small proportion of industrial workers. The author of this system, a mechanical engineer, and its chief advocates — none of whom are physiologists — have formulated rules on quite empirical data derived from "practical" observations which conclude, for instance, that 43 per cent. of a laboring man's time may be under load and that 57 per cent. must be devoted to rest periods in order to gain maximum output.

The slowness of the findings of the physiological laboratory in becoming applied industrially is strange and appears to be due to two causes: first, that physiologists have chosen to limit themselves to pure science and have failed to suggest practical applications for industry, and, secondly, that the criteria or tests for determining fatigue in an individual (whole) man have not been perfected. As against this, the industrial demands have easily brought about the formulating of empirical standards, which, while open to much criticism as unscientific, still, from a practical viewpoint may succeed in doubling a man's daily production on apparently the same expenditure of energy.

There are now two schools of individuals engaged in study of the actual question of industrial fatigue — the first, the *mechanists*, or scientific managers and motion-study experts, as represented by Taylor, Gilbreth, Gantt, and Emerson, who have been busily at work in the field for the past twenty years and, claiming to have solved the question on purely mechanical lines, have fathered an economic movement of great importance; the second, a group of our *physiologists*, represented principally by Lee, Martin, Ryan, Kent, Hill, Florence and others who have been interested in the field of industrial fatigue for a much shorter time. It was largely due to the

* Read before the Section on Physiology, Thirtieth Annual Meeting of the Ohio Academy of Science, held at Columbus, Ohio, May 14 and 15, 1920. Received for publication June 12, 1920.

urgent solicitations of Dr. George M. Kober, Professor of Hygiene, Georgetown University, at the meeting of the American Public Health Association at Jacksonville, Florida, December, 1914, that the interest of American physiologists was first aroused, and there resulted a paper by Dr. Frederic S. Lee at the Rochester meeting of the Association in 1915, entitled *Is the Eight Hour Day Rational?* Later Lee announced *Industrial Physiology, A New Science* (1919), based on the conclusion which most physiologists come to who investigate the subject first hand, that industrial fatigue must be solved *in the factory* or workplace with all its attendant environment because the psycho-physiological tests of the laboratory are not of practical application to industrial workers, nor in factories.

The causes of fatigue in the human being are fairly well understood — enough so that standard rules may be established to circumvent the causes. Two sets of such rules are necessary — the one *intrinsic* and pertaining to the individual and standardizing the well-known factors of nutrition, blood and tissue oxygenation, circulation, elimination, reserve capacity (particularly as affected by disease and impairments), abuse of stimulants, the emotional state, degree of experience and skill, and amount and frequency of rest (or relaxation). Sleep is a phenomenon quite apart and distinct from fatigue. Practically the same amount (length) of it is required whether the individual is working or not, especially if the work is that to which he is accustomed. All of these intrinsic factors are affairs of heredity and growth, physical state of being, and personal hygiene. The status of all is discoverable through the health inquiry and physical examination. Most are governable through education and medical supervision. These intrinsic factors are by far the chief ones in the cause of fatigue; so much so that the writer believes it is only through considerable stress of extrinsic factors that the human body can be fatigued.

This brings us to a brief mention of the chief *extrinsic* factors in industrial fatigue. To itemize briefly, the chief ones of these are: laborious work, long hours, night work, overtime work, lack of periodical days of rest — so-called "one day's rest in seven" — piece work, spurt work, monotony, disharmonious rhythm, strains (such as constant standing, faulty postures and uncomfortable chairs), faulty illumination, faulty ventilation and many forms of distraction such as jarring or jiggling processes and noise. It will be seen that all of these extrinsic factors are fairly easily controllable. The possibility of control of both the intrinsic and extrinsic factors of industrial fatigue suggests the possibility of the total elimination of fatigue in the industrial worker so that he may eventually reach a state of equilibrium in which evidences of fatigue are not detectable. This may seem fanciful, but the writer believes it the ideal condition and one that is often attained, though unwittingly perhaps. In fact, upon a little reflection, most of us will admit the possibility of so arranging the work, nutrition, rest, and environment of the twenty-four hour day (omitting eight hours or so for sleep) that symptoms or signs of fatigue will not become apparent, subjectively or objectively. By developing along these ideal lines, why is it not possible at the same time to skill the human body to a degree of unusual productivity, meantime preventing evidences of any accumulative fatigue even for the space of a single twenty-four hour day?

Spaeth contends that the quantitative degree of fatigue cannot be measured as yet by any reliable method, although a number of reliable qualitative methods are extant. Inasmuch as the subjective sensation of fatigue is quite unreliable, being subservient to the emotional status, and

since we have no reliable method or methods for detecting the amount of fatigue present, the question arises, how do we know when fatigue is present or when it has been eliminated from industry? If a broad view is taken of the possible existence of fatigue in a group of workers and this fatigue considered as purely a group or "mass" affair, a solution seems possible, as follows:

1. Adapt the workers to their jobs, not only by physical and past history examinations, which are necessarily important aspects of the problem, but by a careful selection and specification of standards for personal hygiene for the given job, including rest periods, best work methods, etc. This controls the personal equation.

2. Eliminate those environmental factors, so-called "industrial health hazards," which are known or believed to induce fatigue.

3. Make a practical application of all information gained by following up instances of health disturbances. These are to be sought for in resignations, absences, short-days and times off, mishaps and slips, decreased morale and *health complaints*. A checking up of health complaints requires detective work and an investigation of all instances of objective and subjective findings and sensations commonly known to be associated with fatigue (whether with other bodily states or not), such as headache, muscle pains, lethargy, anxiety, fatigue facies, postures and attitudes, dyspepsia, depression, decreased initiative, etc., etc.

4. Watch the output not so much from the point of view of quantity as of perfection, since fatigued workers may put out quantity but are less apt to satisfy the demands of quality.

Different amounts of fatigue in a group of workers are discernable as follows: *A day's fatigue* results in simple "tired looks," health complaints, stayed enthusiasm, and inaccuracies of execution. *A week's fatigue* results in obvious listlessness, minor indispositions, leaves of absence, loafing on the job, decreased morale, and incorrect attitudes, both physical and mental. *A month's or a year's fatigue* results in evident bodily afflictions (temporary or chronic, associated with deformity or impairment, both physical and mental), quite complete loss of morale and noticeable imperfections in work performed both as to quantity and quality. Obviously, the point of attack is the day's fatigue. Does the work group "quit fresh" as it is believed it should, or with fatigue evidences which even the next meal will not efface?

To sum up, then, industrial fatigue seems capable of elimination by attention to known methods of grading the personnel, specifying and exacting personal hygiene, enforcing correct environmental hygiene, and by using as a check "mass" signs of the day's fatigue in a group of workers.

DETERMINATION OF ANILINE VAPORS IN THE AIR*

MIRIAM STEWART ISZARD, M.A.
Instructor, Laboratory of Hygiene, University of Pennsylvania

TO be able to determine quantitatively the existence of a toxic substance in a definite volume of air is an important factor in bringing about improvement in industries where existing conditions are such that the substance in question is a menace to the health of the employees. The work considered in this article was undertaken with the purpose of finding a method whereby the percentage of aniline vapors existing in the air can be determined.

Previous Work

The toxicity of aniline is not a debatable question. Dr. Malden, in his report upon the examination of the blood of persons employed in aniline dye plants and suffering from aniline poisoning, confirms the results obtained from animal experimentation and proves the effect of aniline upon the blood of the worker (1). In Dr. Neisser's *Internationale Uebersicht über Gewerbehygiene* (2) the report is given of a medical investigator in England, showing the effect of aniline upon the worker. Dr. Thompson (3) in his book, *Occupational Diseases*, cites a number of cases of aniline poisoning reported by authorities working on aniline poisoning in Germany, France, and Austria. Drs. Hayhurst and Kober (4) recognize the highly toxic power of aniline, claiming the poison may be "absorbed through the skin by direct contact or from saturated clothing, by inhalation of vapors and impalpable dust, and also by way of the digestive tract." These men refer to the reports made by Dr. Apfelbach in 1913 and Dr. Birge in 1914, on cases of aniline poisoning in the United States.

Of the work done by investigators interested in aniline poisoning in the United States, two interesting reports have been given, one by Drs. R. V. Luce and Alice Hamilton (5) in an article in the *Journal of the American Medical Association;* the other a bulletin by Dr. Hamilton (6) on industrial poisons used in the rubber industry.

Besides the reports of medical inspectors proving the fact that aniline is a highly toxic substance both in the form of a vapor and of a liquid, we have the experiments of Professor Rudolph Kobert with measured quantities of gases, showing that aniline is one of the most dangerous of toxic gases, very small quantities being poisonous. Kobert (7) has shown that 0.0004–0.0006 gm. per liter can be inhaled for one-half to one hour without severe symptoms, and that 0.0001–0.00025 gm. per liter give slight symptoms after several hours of continued exposure. Kobert, basing his statement on the fact that a worker taking 25 gm. of aniline died of aniline poisoning, says that the lethal dose of aniline for man is under 25 gm. (8).

The articles mentioned consider the toxic effect of aniline upon individuals. I have, however, been unsuccessful in finding any work dealing with a method for determining aniline quantitatively in and about the air of industries manufacturing aniline and aniline products.

Methods of Titrating for Aniline in Solution

Working on the assumption that aniline exists in the air as a vapor or attached to dust particles flying in the air, it was necessary to find some method of getting it into

* Received for publication June 15, 1920.

solution so as to carry on titration. We know that aniline unites by direct addition to acids to form salts (9), as:

$$C_6H_5NH_2 + HCL = \underbrace{C_6H_5NH_2 \,.\, HCL}_{\text{aniline hydrochloride}}$$

Having obtained an aniline salt in solution, the next problem was to devise a method for titrating such a solution in order to determine the amount of aniline present in the sample. Before a suitable method was obtained several different methods were employed and variations of these tried out. I shall here mention two methods which gave satisfactory results.

In determining the value and hence the accuracy of these methods, a definite weighed amount of freshly distilled aniline (1 gm.) was added to 100 c.c. of an approximately 10 per cent. solution of hydrochloric acid, and all titrations were made with this solution. In discussing my methods I shall speak of this as the standard sample. In all titrations a 50-c.c. burette graduated in 0.1 c.c. and giving 2 drops to a tenth was used.

Titrations

Method I. — This method is a modification of a method used by the research department of a plant working with aniline and aniline products. The materials used are:

1. Sodium nitrite solution — approximately 17.25 gm. to 1 liter of water, standardized every few days.

2. Starch iodide paper prepared according to the Frankford Arsenal formula.

A definite volume of the standard sample is cooled to 5 C. in an ice bath by adding cracked ice to the solution. It is titrated with sodium nitrite solution, not more than 1 c.c. being added to the nitrite at a time, and only one drop at a time toward the end. The first end point is taken when the solution gives an immediate blue color after fifteen seconds stirring when spotted upon the starch iodide paper. Next, the temperature of the solution is brought up to 10° C. At this temperature the reaction on the starch iodide paper should be negative. Then sodium nitrite is added, a drop at a time, with thirty seconds stirring between each drop. An immediate blue color, which lasts five minutes after the last previous addition of nitrite, is the final end point.

Calculation:

$$\frac{\text{c.c. } NaNO_2 \times \text{aniline equivalent to 1 c.c. } NaNO_2}{\text{no. c.c. of sample}} = \text{aniline present in 1 c.c. of sample.}$$

This method is an accurate one since in all ten tests made with it I was able to account for within 0.3 mg. of the exact amount of aniline placed in the sample.

Method II. — This method was furnished to me by the company through whose courtesy the practical application of my methods was made possible. The titration as furnished by them was as follows:

Analysis of Aniline, Aniline Salt, and Standardization of Sodium Nitrite Solution

Reaction. — $(C_6H_5NH_2 \,.\, HCl) + NaNO_2 + HCl = (C_6H_5N - NCl) + NaCl + 2\,H_2O$

Solution. — (1) Sodium nitrite solution approximately 10 per cent.

(2) Starch potassium iodide solution from bottle which must be used only three days after opening.

(3) Aniline for standardization is prepared by distilling commercial aniline through a clean condenser and collecting the middle portion over a range of 0.2° C. This special aniline is to be kept in a glass stoppered bottle and labeled "Aniline for Standardization."

Standardization. — Weigh out accurately about 10 gm. of aniline for standardization in a glass stoppered weighing bottle. Pour into a 500-c.c. beaker containing ice which has been washed. Wash weighing bottle and stopper with 50 c.c. of 10 per cent. hydrochloric acid. Stir with a paper scale thermometer (C. 100°), protecting the mercury bulb against breakage by slipping a three-fourths inch piece of black connection tubing over it. Add 25 c.c. concentrated hydrochloric acid. See that all aniline

hydrochloride crystals that are formed on addition of concentrated HCl are dissolved. Add distilled water sufficient to make total volume about 250 c.c.

First End Point. — When the temperature is between 5° and 8°C. add the sodium nitrite solution, drop by drop, from a burette at a rate not exceeding 2 c.c. per minute, constantly stirring. Continue adding the sodium nitrite solution until a drop of the solution taken out on the end of the thermometer and dropped on a drop of starch iodide solution on a spot plate gives an immediate blue color. If the temperature is between 7° and 8°C., this is the first end point. If the temperature is below 7°C., it must be raised to between 7° and 8°C. for the first end point.

Final End Point. — Set the beaker in a pan of water at 13° and stir solution until temperature is just 12°. (Caution: — Do not warm over flame or steam bath as the diazo benzene chloride formed is decomposed by heat.) The solution should now give no blue test; if it does the end point has been passed and a new sample will have to be started.

If no blue test is obtained, keep temperature between 12° and 13° and resume titration, adding 4 drops of nitrite solution, testing after exactly fifteen seconds stirring. (Use watch.) When an immediate blue has been obtained at this rate, the titration rate is changed to 2 drops of nitrite solution, testing after thirty seconds stirring, when a blue test constitutes the end point. The solution after being stirred an additional two minutes must still give an immediate blue test and final temperature must be 13°.

Calculation. — *Example:* Divide the cubic centimeters of sodium nitrite used into the weight of the aniline and the result will be the weight of the aniline to 1 c.c. sodium nitrite solution.

$$\begin{array}{r} 17.8297 \\ 6.9427 \\ \hline 10.8870 \end{array} \text{ gm. aniline}$$

Used 86.9 c.c. $NaNO_2$ solution

$$\frac{10.8870}{86.9} = \begin{cases} 0.12528 \text{ gm. aniline per} \\ \text{c.c. } NaNO_2 \text{ solution} \end{cases}$$

Analysis of Aniline, Aniline Water, and Aniline Salt. — To analyze aniline, aniline water and aniline salt, proceed exactly as in the standardization. Be careful to wash all of the sample from the weighing bottle, using a wash bottle containing a 10 per cent. solution of hydrochloric acid.

Calculation:

$$\frac{\text{aniline equivalent to 1 c.c. } NaNO_2 \times \text{no. c.c. } NaNO_2}{\text{amount of sample in c.c.}}$$

= aniline present in 1 c.c. of sample.

Precautions. — When titrating for the first end point or at any one of the specified rates, an immediate blue must be obtained before going to the next rate. Emphasis is placed upon an immediate blue because all tests turn blue slowly on using 1 drop of nitrite solution in 400 c.c. of distilled water containing 25 c.c. of concentrated hydrochloric acid, on stirring thirty seconds. A good starch solution will give an immediate blue free from any reddish tinge.

This method was employed by me with the following modifications:

1. A 1 per cent. solution of sodium nitrite was used instead of a 10 per cent. solution.

2. Starch potassium iodide paper the same as used in method I was used instead of potassium iodide solution.

3. In standardizing, 1 gm. of aniline was used instead of 10 gm.

4. In adding sodium nitrite solution, never more than 0.1 c.c. was added at a time and the solution was always stirred fifteen seconds between each addition. These changes were made because I was dealing with a very weak solution of aniline salt. The results of the titrations proved that this method could be used with the same degree of accuracy as method I.

Summarizing the results of the above two methods of titrating, I found both sufficiently accurate to be employed in carrying out future phases of this problem. The following points and precautions are to be remembered:

1. The sodium nitrite solution should be made up fresh every few days and should be restandardized each day, because of the danger of deterioration due to bacterial action.

2. At least two check titrations should be made on each sample.

3. The temperature should be held at the exact degree stated in the methods for a change in temperature of 1°C. means a change of 0.1 c.c.–0.3 c.c. in the final end point.

Tests of Apparatus

Having determined that the above methods were sufficiently accurate to detect small amounts of aniline in solution, the next phase of my problem was to devise a method of collecting aniline vapors from the air. Three different kinds of apparatus presented themselves as feasible for use: namely, the Palmer dust collecting apparatus, the carboy, and the Pettenkoffer absorption tube.

Since aniline vaporizes a little above room temperature and boils at 363°F., a flask containing freshly distilled aniline was weighed, and by means of a double-bore stopper was attached directly to a condenser through one bore, and by means of a bent glass tube in the other bore was directly connected with the apparatus to be employed in collecting the vapor. The purpose of the condenser was to recondense any escaping aniline if the fumes became too heavy to pass over to the apparatus. When the apparatus was attached, a slow gas flame was put under the flask containing aniline, the weight of which had been determined previously. Just sufficient heat was applied to let the aniline fume slowly. When all the fumes had passed into the apparatus, the flask of aniline was reweighed, the difference in weight being the amount taken up by the apparatus. Each of the three methods was tried in turn, their efficiency being determined by using titration methods I and II, and determining how nearly the loss in aniline weight checked up with the amount accounted for in the samples collected. If the results checked up within 0.001–0.003 gm., they were considered to be accurate. Tests were made by passing known volumes of the fumes of aniline through a 10 per cent. solution of hydrochloric acid in carboys, Pettenkoffer tubes (10), and Palmer dust collecting apparatus (11). The results of these tests showed that:

A. The carboy could be used, for all the fumes of aniline introduced into the acid were accounted for to 0.001 gm. In using this method for determining the amount of aniline present in the air, however, it was necessary to use a carboy having a volume of at least 15,000–20,000 c.c., since the amount of aniline in a smaller volume than 20,000 c.c. of air would probably be too small to be determined with any degree of accuracy.

B. The Pettenkoffer tube method was a feasible method if two tubes were joined and the fumes allowed to pass from one to the other. Also by introducing a plug of glass wool 1 inch in length at the proximal end, greater surface was obtained. The value of this apparatus lies in the fact that the long tubes gain more thorough absorption.

C. The Palmer dust collecting apparatus was tried out but proved inefficient because the air passed through the column of acid too rapidly and the column was too short to entrain all the aniline.

In summing up my preliminary work, I found that titration methods I and II would show the presence of 0.001 gm. or more of aniline and that both the carboy and Pettenkoffer tube methods were possible means of determining the amount of aniline existing free in the air. The Palmer dust collecting apparatus is of no value in determining the amount of aniline existing free in the air, but in any process using aniline, accompanied by a great amount of dust, this apparatus can be employed by using a medium for entraining the dust particles and one in which the aniline is soluble. A consideration of this method as a means for determining aniline in industrial dust is to be given in another article.

Practical Application of the Methods Tested

In trying out the methods described, a series of tests was run at a plant where

aniline and aniline products were manufactured. The plant where this work was conducted was a modern one, the company constantly endeavoring to improve conditions hazardous to health. Before beginning the tests, therefore, I felt that aniline, if present, would be found in very small quantities, in which case the methods, if practical, would be all the more valuable. Aniline at the plant in question existed in two forms: namely, (1) as free aniline vapor in the air, and (2) as aniline attached to the flying dust where the process was a dusty one. The aniline house and the indigo house were suggested by the company as possible places for detecting aniline in these forms.

Aniline. — In the manufacture of aniline there are two phases where it is possible to find aniline escaping into the air: (1) When the reducers are dropped, the aniline passes from the reducer into the still as a very hot liquid. Formerly this fuming aniline was dumped into an open pan placed over the still hopper, hence letting great amounts escape into the air, and frequently it was seen to slop over the side. At present the amount of aniline escaping is reduced by the installation of air suction pipes from the hoppers, which draw the vapor downward. The aniline which does escape exists in the air as vapor. To drop a reducer takes about twenty minutes, all conditions being satisfactory. (2) After distillation the tank containing the residue (iron oxide) at the base of the still is opened for cleaning. When this takes place the iron oxide dust passes into the air carrying with it considerable attached aniline. This process requires about ten minutes. At intervals the worker, standing in front of the tank, helps along the process with a long pole.

Indigo. — The one phase of the process of making indigo where aniline can escape into the air in quantity is when the driers are opened, tilted and the phenylglycine is shoveled by hand into barrels. Clouds of phenylglycine containing more or less free aniline at this time escape into the air. The worker here is supplied with a respirator and gloves as means of protection, but respirators up to the present time are not satisfactory and the workers do not wear them. At this phase of the process the aniline escapes into the air, either as a vapor from the fuming lumps of phenylglycine or attached to the particles of dust. It should be noted here that the company at the plant of which the experiments were made is at present dissatisfied with the present vacuum driers, which are German made, and are installing vacuum drum driers, which will do away with a great deal of the dustiness. This change is being made because of the fact that so many workers are reported ill from time to time in this department and the company, feeling this is due either to the toxicity of the phenylglycine or to the aniline, are introducing the new American-made machinery.

Tests for Aniline Vapors

At the plant studied tests were made for free aniline vapors in the air using the Pettenkoffer and carboy methods. These tests were carried out by setting up the apparatus at two different levels, namely, floor level and the level of the worker's mouth. All tests were made at the same distance from the process as that at which the worker conducting the process stood. The tests were made in the aniline house while the reducers were being dropped and in the indigo house while the vacuum driers were being emptied.

In carrying out the tests two methods were employed in collecting the samples. These methods were as follows:

1. *Carboy Method.* — Carboys ranging in volume from 15 to 20 liters were filled with water (aniline-free), and were emptied at the source of collection of the sample, being thus filled with air to be tested for aniline. The amount of water expelled was

noted for this measured the amount of air introduced. Immediately 200 c.c. of an approximately 10 per cent. solution of hydrochloric acid were poured into the carboy, the carboy stoppered and agitated freely at intervals for one-half hour. It was then allowed to stand for one-half hour to permit thorough absorption of the aniline

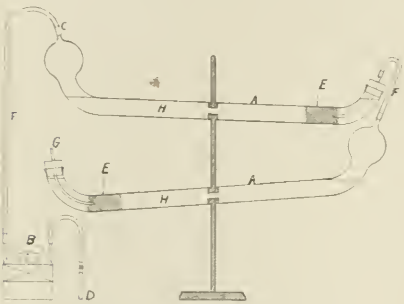

Fig. 1.—Arrangement of apparatus in Pettenkoffer tube method of determining aniline vapors in air.

A. Pettenkoffer tube. B. Gas meter. C. In preliminary tests, point of attachment to aspiration apparatus; in application of method, point of attachment to gas meter. D. Point of attachment to vacuum. E. Glass wool. F. Rubber tubing. G. In preliminary tests, point of attachment to flask of aniline; in application of method, point of entrance of sample. H. Ten per cent. solution hydrochloric acid.

by the hydrochloric acid. The sample was then poured off into 250-c.c., clean, glass-stoppered bottles and titrated.

2. *Modification of the Pettenkoffer Tube Method Used for Determining Per Cent. of Carbon Dioxide in Air.*—Two Pettenkoffer tubes were connected by means of rubber tubing to each other and then connected with a gas meter which was connected with a vacuum. The tubes were filled with about 100 c.c. of an approximately 10 per cent. solution of hydrochloric acid, glass wool being placed at the proximal end of each tube. The air to be tested was then allowed to bubble through the tubes as slowly as possible, and the number of cubic feet of air drawn through the tubes recorded by the gas meter. (See Fig. 1.) The samples were placed in 100-c.c. bottles and the tubes washed with hydrochloric acid solution. The samples and washings were titrated.

An explanatory note should be given to the tabulated results of the tests (Table 1). Samples 1 and 2 were taken at the floor level, whereas samples 3, 4 and 5 were taken at the level of the worker's mouth. Sample 2 shows a higher percentage of aniline than sample 1, but it took longer to empty the reducer, during the dropping of which sample 2 was taken, than it did to empty the reducer during the dropping of which sample 1 was taken. In dropping the second reducer, the reducer became clogged with iron oxide and, in opening up, the liquid slopped out and collected in a tray, permitting more aniline fumes to escape than is customary. This accounts for the high aniline content of the air. Sample 2 by the carboy method shows a lower percentage of aniline than the same by the Pettenkoffer method; this is due to the fact that the carboy sample was taken before the aniline began to slop over the sides.

Significance of the Preceding Tests

As regards the tests for free aniline in the air, the following points should be emphasized:

(a) An appreciable amount of aniline was obtained from the air by both the carboy and Pettenkoffer methods. Moreover, the results of these two methods made on the same sample checked up very well. The value of the Pettenkoffer tube over the carboy is that it is easier to handle and hence more practical. Also larger samples can be obtained, for the Pettenkoffer apparatus can be set up and allowed to run continuously for as long a time as desired.

(b) Considering that according to Kobert 0.0004 gm.–0.0006 gm. of aniline per liter in the air can be breathed for one-half to one hour without severe symptoms, and 0.0001 gm.–0.00025 gm. per liter is the

smallest amount that after continued exposure will produce slight symptoms (5), we find that the results of all titrations show, with the exception of sample 3, that the workers in the plant studied were working under more or less toxic conditions. It must be borne in mind, however, that the workers are constantly moving about and not breathing continuously the air containing such a high percentage of aniline.

(c) The results of tests show that at the floor level the amount of aniline is decidedly greater than at the respiration level. This is due to the fact that aniline is much heavier than air and hence stays near the floor.

TABLE 1. — TABULATED SUMMARY OF RESULTS OBTAINED FROM TESTS MADE IN ANILINE AND INDIGO BUILDINGS

No. of Sample	Phase of Process Involved	Duration of Process in Minutes	Method Used in Collecting Samples	Method of Titrating	Amount of Aniline in Grams in Sample	Amount of Air Sample Collected in Liters	Amount of Aniline in Grams in 1 Liter of Air	Amount of Aniline in Grams Worker Inhales during Process	Per Cent. of Aniline in Acid Sample Collected
1	dropping reducer	20	Pettenkoffer	I	0.035403	34.809	0.00101	0.1722	0.009
1	dropping reducer	20	carboy	I	0.016527	13.930	0.00118	0.2004	0.0033
2	dropping reducer	40	Pettenkoffer	I	0.0653275	18.753	0.0034	1.176	0.0041
2	dropping reducer	40	carboy	I	0.044859	18.425	0.00243	0.8257	0.0135
3	dropping reducer	20	Pettenkoffer	I	0.02118	40.469	0.0005	0.08888	0.0052
4	emptying of phenylglycine in indigo house	20	Pettenkoffer	II	0.04236	58.581	0.0007	0.1224	0.1126
5	emptying of phenylglycine in indigo house	30	Pettenkoffer	II	0.04944	43.582	0.0017	0.2889	0.1106

Conclusion

The results of tests made for determining quantitatively the presence of aniline vapors in the air have given rise to the following conclusions:

1. The sodium nitrite test as described under methods I and II of the titrations is an accurate quantitative method for analyzing the presence of aniline in weak solutions.

2. The carboy method can be used for determining quantitatively the presence of aniline in the air, but the method is an awkward one owing to the fact that the carboy must be large enough to give a sufficient volume of the sample (at least 25,000 c.c. of air).

3. The Pettenkoffer method, as previously described, is the best method for determining quantitatively the presence of aniline vapors in the air. It is valuable because (a) it can be run over a longer period of time and hence a larger sample can be obtained; (b) the apparatus is portable for it can be taken apart and carried in a small bag; (c) it is efficient since slow absorption can be obtained by means of the long tubes and the addition of glass wool. Additional surface can be obtained by introducing glass beads. The greater the resistance the more complete will be the absorption of the aniline vapors.

4. In collecting a sample of aniline from the air sufficient should be collected to make at least two titrations on each sample. The longer the experiment is run the larger will be the amount of aniline present and the more accurate will be the results.

5. The results show that aniline is present in the air surrounding buildings where aniline and aniline products are made, its presence being greater near the floor than at the respiration level.

The above results point toward the use of Pettenkoffer tubes as a feasible method for determining quantitatively the presence of aniline vapors in the air.

The author wishes to express her appreciation of the assistance of Dr. Henry F. Smyth, Laboratory of Hygiene, University of Pennsylvania, under whose guidance and supervision this work was carried out, and for the courtesies met with and the help received from the company through whose kindness the practical application of the methods was made possible.

BIBLIOGRAPHY

1. Malden, W.: Some Observations on the Condition of the Blood in Men Engaged in Anilin Dyeing and the Manufacture of Nitrobenzene and its Compounds. Jour. Hyg., 1907, **7**, 672.
2. Neisser, E. J.: Internationale Uebersicht über Gewerbehygiene, nach den Berichten der Gewerbe-Inspektionen der Kulturländer. Berlin, Gutenberg Verl., 1907, p. 75.
3. Thompson, W. G.: The Occupational Diseases. New York and London, D. Appleton and Company, 1914, p. 307.
4. Kober, G. M., and Hanson, W. C.: Diseases of Occupation and Vocational Hygiene. Philadelphia, P. Blakiston's Son and Company, 1916, pp. 545 and 569.
5. Luce, R. V., and Hamilton, A.: Industrial Anilin Poisoning in the United States. Jour. Am. Med. Assn., 1916, **66**, 1441.
6. Hamilton, A.: Industrial Poisons Used in the Rubber Industry. U. S. Bur. Labor Statis. Bull. No. 179, 1915, pp. 17–20; (from appendix by R. V. Luce) pp. 57–58.
7. Kobert, R.: Kompendium der Toxikologie. Stuttgart, 1912, pp. 44–45.
8. Kobert, R.: Lehrbuch der Intoxikationen, Vol. 2. Stuttgart, 1906, p. 789.
9. Thorpe, *Sir* Edward: A Dictionary of Applied Chemistry, Vol. 1. New York and London, Longmans, Green and Company, 1918, p. 263.
10. Bergey, D. H.: Handbook of Practical Hygiene. Easton, Pa., Chemical Publishing Company, 1899, pp. 54–55.
11. Palmer, G. T.: A New Sampling Apparatus for the Determination of Aerial Dust. Am. Jour. Pub. Health, 1916, **6**, 54.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II — DECEMBER, 1920 — NUMBER 8

ACID BURNS AND THEIR TREATMENT*

G. A. WELSH, M.D.

Medical Officer to H. M. Factory, Gretna

Statistics

An analysis of the records at the dressing station on the acid section during the period from August 14, 1916, to September 30, 1919, shows that one out of every four cases was treated for an acid burn; the actual number of cases treated at the station amounts to 17,414; acid burns account for 4,292. A more detailed analysis of the acid burns showing the plant of incidence and classifying the degree of the burn gives the following figures:

	Slight	Severe	Serious
Grillo oleum	154	16	5
Mannheim oleum	62	12	4
Nitric acid retorts	1117	42	10
Nitric acid mixers	294	24	9
Nitric acid stills	410	18	3
De-nitrators	116	4	2
Gaillard towers	170	14	..
Laboratories	84	9	2
Nitro cotton nitrating	1621	87	3
	4028	226	38

The definition of the terms used is as follows:

Slight. — A burn which does not incapacitate the worker for work or which is healed and allows the worker to return to work under ten days.

Severe. — A burn which incapacitates the worker for fourteen days or over, and which varies in degree up to one which incapacitates the worker for as much as four weeks.

Serious. — A burn by which the worker is incapacitated for over four weeks, and which in a large proportion of cases leaves a degree of permanent incapacity.

To illustrate this I append an analysis of the compensation list record showing the occupation, plant of incidence, nature of the acid causing the injury, part affected and period of incapacity (Tables 1 and 2) in ninety cases of acid burns.

General Considerations

A condition which causes 25 per cent. of the cases dealt with arrests the attention, quite apart from the intrinsic importance of the subject. One outstanding feature of these figures is the large proportion of cases which are classified as slight. This speaks very much in favor of the thoroughness of the precautions taken to prevent accident and shows that an efficient first-aid system is of real value.

* Received for publication June 21, 1920.

In dealing with the subject of acid burns in a factory such as H. M. Factory, Gretna, where the production of acid is on a large scale and constitutes an engineering as well as a chemical problem, I propose to do so by introducing short descriptions of things not purely surgical, which will elucidate the points I want to emphasize. For the purpose of description I have divided those working the plant into: (a) operatives whose work is chiefly chemical, and (b) operatives whose work is chiefly mechanical. In practice it is, however, difficult to maintain such a hard and fast distinction. In the case of operatives whose work is chiefly chemical, it is possible to protect the exposed surfaces — e. g., the hands by rubber gloves and the eyes by goggles. In the case of operatives whose work is chiefly mechanical, this is not possible as the workman is using tools and cannot work so efficiently if his touch is dulled or his sight in any way blurred. This was the attitude of the workmen and made it very difficult to adopt precautionary measures. The fact is important because in the majority of cases the escape of acid from a closed system was due to an accident closely connected with a breakdown in the machinery. It is also germane to mention that the escape of acid was often sudden and with considerable force behind it, due to the pressure in the system.

In the process of cotton nitration we have an illustration of how the mechanical element enters into the work of a chemical operative. We have also an example of the value of protecting exposed surfaces. To prepare the pan for nitrating, the operative has to push the cotton into the mixed acid with a long handled fork, and, when the pan is full, to place in position the earthenware top. Both of these operations are mechanical and if not carefully performed displace the acid and cause splashing. In 96 per cent. of the cases from the nitrating house, the acid burn was caused by the acid splashing.

The mechanical operative in the ordinary course of employment soils his hands and when an accident happens the acid comes in contact with the dirty surface — in many instances with abrasions and cuts. It did not take me many visits of inspection to see how dirty the hands of some of the workmen were and to appreciate how difficult it would be to prevent sepsis. The importance of this point was speedily impressed upon me; in the early days I saw numerous cases where the acid burn was so slight it gave the workman no concern at the time. He only reported for treatment when sepsis developed and this caused an unnecessary prolongation of the period of incapacity. To remedy this, I recommended the section manager to issue instructions for every case of acid burn to report at the dressing station. The nurse had instructions to clean the burned part and surroundings thoroughly before applying the final dressing. It took some time for this advice to be appreciated at its proper value but eventually there was a general conversion and many hours of labor were saved to the factory, and a smaller compensation list resulted. Summarizing, I wish to emphasize three points: (1) that it is of prime importance to protect as far as possible exposed surfaces — e. g., the hands and the eyes; (2) that it is essential to take every step to avoid sepsis; (3) that the operatives should be taught to look after the state of their hands and pay special attention to cuts and abrasions.

Varieties of Acid

The acids manufactured are: concentrated sulphuric acid, oleum, and concentrated nitric acid. These acids are mixed in varying proportions to produce mixed acids for nitrating purposes. In addition to these, the spent acids left after nitrating are de-nitrated and weak sulphuric acid and nitric acid recovered for further use.

TABLE 1. — LIST OF INJURIES CAUSED TO MALE WORKERS ON THE ACID SECTION BY ACID BURNS

Case	Occupation	Plant where injury happened	Nature of acid causing injury	Part affected by burn	Period of incapacity in weeks
1	fitter's helper	nitric acid retorts	mixed acid	face	1
2	chemical operative	nitric acid retorts	cold nitric	eye	1
3	chemical operative	Gaillard towers	cold weak sulphuric	both eyes: r. slight; l. mod. severe. Face and forehead slight	1
4	chemical operative	acid mixers	concentrated sulphuric	acid splash in eye	1
5	chemical operative	acid mixers	weak cold sulphuric	face	1
6	leadburner	nitric acid retorts	cold strong nitric	face	1
7	chemical operative	nitric acid stills	cold nitric	right eye	1
8	chemical operative	Mannheim oleum	cold weak sulphuric	face	2
9	chemical operative	nitro cotton mixers	cold nitro cotton mixed	face and eyelids	2
10	laborer	Gaillard towers	cold weak sulphuric	hand	2
11	chemical operative	acid mixers	cold oleum	face	2
12	fitter's helper	grillo oleum plant	cold sulphuric	arm	2
13	chemical operative	nitro cotton mixers	cold nitro cotton mixed	wrist and thigh	2
14	laboratory chemist	laboratory	cold strong sulphuric	eye	2
15	chemical operative	acid mixing	cold oleum	neck	3
16	chemist's assistant	sulphuric acid laboratory	concentrated cold sulphuric	arm	3
17	laborer	oleum weigh house	cold strong sulphuric	side of neck and ear	3
18	gas producer operative	nitric acid stills	weak sulphuric	foot	3
19	fitter	acid mixers	cold mixed acid	finger	3
20	chemical operative	nitric acid stills	cold nitric	face	3
21	fitter's helper	acid mixers	cold mixed acid	eye	3
22	chemical operative	acid mixers	cold nitroglycerine mixed	face	3
23	chemical operative	nitric acid retorts	molten nitrecake	hand	3
24	chemical operative	nitric acid retorts	molten nitrecake	hand	3
25	chemical operative	nitric acid retorts	molten nitrecake	right eye	3
26	chemical operative	nitric acid retorts	cold nitric	finger	3
27	engineer	nitric acid stills	hot sulphuric	leg	3
28	chemical operative	grillo oleum	cold oleum	face and neck, l. eyelid and eye	4
29	chemical operative	Mannheim oleum	cold oleum	arm	4
30	fitter	grillo oleum	cold oleum	face and neck	4
31	leadburner	de-nitrators	spent nitroglycerine	head and neck	4
32	chemical operative	nitric acid retorts	cold strong nitric	left arm	4
33	chemical operative	nitric acid retorts	cold strong nitric	foot	4
34	chemical operative	nitric acid retorts	hot nitrecake	hand	4
35	bricklayer	nitric acid stills	cold strong nitric	hand	4
36	chemical operative	nitric acid retorts	hot nitrecake	hand and arm	4
37	chemical operative	grillo	sulphuric	hand	5
38	chemical operative	nitric acid retorts	molten nitrecake	arm	5
39	chemical operative	nitric acid retorts	molten nitrecake	hand and arm	6
40	chemical operative	acid mixing	weak nitric	foot; burn neglected	7
41	chemical operative	nitric acid retorts	cold strong nitric	hand	$7\frac{1}{2}$
42	fitter	grillo oleum	cold strong sulphuric	face, neck and arm	8
43	chemical operative	acid mixing	cold oleum	leg	8
44	fitter	oleum weigh house	cold strong sulphuric	face, eyes, forehead and l. arm	9
45	chemical operative	nitric acid stills	cold strong nitric	1st finger l. hand: sepsis followed causing necrosis and loss of 1st phalanx	10
46	chemical operative	nitric acid retorts	hot strong nitric	foot	15
47	chemical operative	acid mixing	cold mixed nitroglycerine	both hands, lower part of back and both buttocks	17
48	chemical operative	acid mixing	cold mixed nitroglycerine	face, arms and back. Severe burns affecting both eyes; l. eye became septic and had to be excised	30
49	chemical operative	acid mixing	cold strong nitric	severe burn of l. eye, head and face and eventually loss of sight of l. eye; incapacitated long period. Claim settled by payment of £300	
50	chemical operative	acid mixers	cold strong sulphuric	eyes and face; l. eye, which had been seat of old injury, became septic and man died of septic meningitis	
51	chemical operative	Mannheim oleum	cold strong sulphuric	acid burn affecting eyes, eyelids and face; the operative is totally incapacitated and has developed tuberculosis	

TABLE 2. — LIST OF INJURIES CAUSED TO FEMALE WORKERS ON THE ACID SECTION BY ACID BURNS

Case	Occupation	Plant where injury happened	Nature of acid causing injury	Part affected by burn	Period of incapacity in weeks
1	chemical operative	nitrating house	nitro cotton mixed acid	right hand	1
2	chemical operative	nitrating house	nitro cotton mixed acid	acid splash, both eyes	1
3	chemical operative	nitrating house	nitro cotton mixed acid	arm	1
4	chemical operative	nitrating house	nitro cotton mixed acid	foot	1
5	chemical operative	grillo oleum	strong cold sulphuric	shoulders, neck and face; acid splash in eye	2
6	chemical operative	nitrating house	nitro cotton mixed acid	left forearm	2
7	chemical operative	nitrating house	nitro cotton mixed acid	eye	2
8	chemical operative	nitrating house	nitro cotton mixed acid	both feet	2
9	chemical operative	nitrating house	nitro cotton mixed acid	left thigh and ankle	2
10	chemical operative	nitrating house	nitro cotton mixed acid	arm	2
11	chemical operative	nitrating house	nitro cotton mixed acid	foot	2
12	chemical operative	nitrating house	nitro cotton mixed acid	foot	2
13	chemical operative	nitrating house	nitro cotton mixed acid	eyes	2
14	chemical operative	nitrating house	nitro cotton mixed acid	fingers	2
15	chemical operative	nitrating house	nitro cotton mixed acid	hands	2
16	chemical operative	nitrating house	nitro cotton mixed acid	both eyes	2
17	chemical operative	nitrating house	nitro cotton mixed acid	hands and knees	3
18	chemical operative	nitrating house	nitro cotton mixed acid	right arm	3
19	chemical operative	nitrating house	nitro cotton mixed acid	finger	3
20	chemical operative	nitrating house	nitro cotton mixed acid	arm	3
21	chemical operative	nitrating house	nitro cotton mixed acid	wrist	3
22	chemical operative	nitrating house	nitro cotton mixed acid	fingers and eye	3
23	chemical operative	grillo oleum	cold oleum	eye	4
24	chemical operative	nitrating house	nitro cotton mixed acid	left instep	4
25	chemical operative	nitrating house	nitro cotton mixed acid	wrist	4
26	chemical operative	nitrating house	nitro cotton mixed acid	leg	4
27	chemical operative	nitrating house	nitro cotton mixed acid	hands	4
28	chemical operative	nitrating house	nitro cotton mixed acid	foot	5
29	chemical operative	nitrating house	nitro cotton mixed acid	arm	5
30	chemical operative	nitrating house	nitro cotton mixed acid	foot	5
31	chemical operative	nitrating house	nitro cotton mixed acid	back	5
32	chemical operative	nitrating house	nitro cotton mixed acid	foot	6
33	chemical operative	nitrating house	nitro cotton mixed acid	foot	6
34	chemical operative	nitrating house	nitro cotton mixed acid	r. instep, septic	7 w. 4 d.
35	chemical operative	nitrating house	nitro cotton mixed acid	burn of arm	12
36	chemical operative	nitrating house	nitro cotton mixed acid	eye; sight of eye injured; since died from pneumonia	15
37	chemical operative	nitrating house	nitro cotton mixed acid	acid burn injuring sight of r. eye. Settled by payment of £100	over a year
38	chemical operative	nitrating house	nitro cotton mixed acid	burn of eye causing loss of sight. Settled by payment of £100	over a year
39	chemical operative	nitrating house	nitro cotton mixed acid	cut finger from cracked nitrating pan, burned at same time with nitro cotton acid	24

During the course of this de-nitration process, the temperature of the acid is raised to a considerable degree. In the case of weak sulphuric acid a temperature of 200°C. is reached. Lastly there is a by-product obtained from the manufacture of nitric acid, an acid sulphate of soda called nitrecake, which is discharged from the retorts in a molten state at about 150°C. to cooling pans. It follows that an operative may be burned with oleum alone, with sulphuric acid alone, with nitric acid alone, with mixed acid, or with nitrecake at a high temperature.

External Appearances of Acid Burns

It is possible to recognise by external appearances the action of these different acids on the skin. Oleum and sulphuric

acid produce a grayish-brown color; nitric acid produces a bright yellow discoloration; mixed acid produces a reddish-brown color with a faint yellow in it, the yellow being most distinguishable at the margin of the burn. There is, in the early stages, little congestion of the surface when there is no heat acting with the acid. When a burn is inflicted with an acid at a high temperature, as with the molten nitrecake, there is well-marked congestion and bullae are quickly formed. This congestion masks the colors produced by the same acid in the cold state. For purposes of treatment it makes no difference what cold acid produces the burn, and there is only a difference in technique, not in principle, when the part is scalded as well as burned by acid. Concentrated sulphuric acid or concentrated nitric acid falling on the skin of the hands and speedily treated will produce very little effect; a weaker acid with heat produces a burn which gives more trouble. Burns of a mucous surface — e. g., burns of the lips and inside of the mouth, and of the eye — cause a marked reaction and take longer to heal.

Treatment

In dealing with an acid burn everything depends upon the promptness and thoroughness of the first steps taken to treat it. We have here a first-rate example of the importance of what is known as first aid. To ensure promptness of treatment in H.M. Factory at Gretna, a brief description of what should be done was printed and circulated to the section managers and those in authority acting under them. Eventually these rules were incorporated in the factory rule book so that each operative might have the information. The instructions issued were as follows:

> Get rid of surface acid by the application of clean water to the part; this may be done by immersing the part in a tub of water, by playing a hose on it, or by leaving water on it if it is the face or head. Neutralize the acid in the part by applying the alkaline solution and allowing it to act for ten minutes. Gently dry with cotton wool and apply moist picric acid gauze. Cover the surface with a layer of cotton wool and keep in position with a bandage lightly applied. The person who is burned should not be allowed to move the affected part. If the arm is burned a sling should be applied; if the legs are burned a stretcher should be used. The patient should be seen by the doctor as soon as possible. When the part affected is the eye or the mouth, it should be washed with alkaline solution and oil applied over the surface.

First-aid boxes containing the necessary articles for treatment and buckets of clean water were placed all over the plant within easy reach of every operative. These appliances were regularly inspected and an ample supply maintained. In addition to this, as I mentioned earlier, every case was reported to the nurse, who inspected simple cases and reported all severe cases to the doctor. All severe cases had the final dressing applied by the doctor. Cases where a mucous surface was affected or the eye burned were personally treated by the doctor.

The dressing station is placed within three minutes' walk of the most outlying part of the acid section, which is the grillo plant. All the other plants are within half that distance. This station is well heated, is equipped with sterilizing apparatus, has ample bath accommodation and four beds for the detention of any serious cases.

No patient is brought to the dressing station until all surface acid has been got rid of by ample treatment with cold water. In the case of the plant adjoining the station, further stages of treatment are carried out at the dressing station: in the case of an outlying plant, the dressing is applied and removed on arrival for inspection of the burn.

In the cases here reported the nurse obtained the history on arrival of the patient, and if the burn was a simple one dressed it

and reported afterwards. In severe cases the nurse reported by telephone and proceeded to prepare the patient for examination, being particularly careful to remove all acid-soaked clothing before cleaning up the affected area and surroundings. Before dealing further locally with a severe case — e.g., a case in which an extensive surface was affected, or, a special area (the head, face and neck, both eyes or one eye) badly affected — I always took precautionary measures to combat shock. The patient was treated in a temperature between 65° and 70°F.; he was given a hot drink, milk or bovril, and a sixtieth of a grain of strychnine hypodermically. The cleaning and soaking of the burned area with alkaline solution having been thoroughly attended to, moist picric acid gauze (strength 1 per cent.) was applied and the part covered with sterilized cotton wool and lightly bandaged. The alkaline solution which I used was a saturated solution of recrystallized sodium carbonate. This I found to be a very useful agent for cleaning the part as well as neutralizing any free acid in the tissue. During the acute stage of the burn the dressing was changed twice daily, moist picric acid gauze being re-applied over the area. This was continued until healing was well advanced. This dressing was then changed for sterile plain gauze wrung out of normal saline solution. If the covering of the surface with epidermis was in any way delayed, I applied sterile gauze soaked in ten volumes of solution of hydrogen peroxide. In cases where sepsis developed I substituted for the picric acid gauze, gauze soaked in hydrogen peroxide, the pus being gently swabbed away from the surface with normal saline solution. When blisters were present over the burned area I left them untouched for twenty-four hours; they were then pricked, care being taken to make a small opening, and as much of the fluid as could be removed was dried off. On or about the third day, the superficial layer was excised by means of scissors and the picric acid dressing continued.

Eye Cases

External Appearances. — In the case of a moderately severe eye burn, the external appearances consist in edema of the conjunctiva with well-marked injection of the burned part and its surroundings. Severe pain is complained of and photophobia is marked. If a concentrated acid gains entrance to the eye in any quantity there is very quickly developed stasis in the corneal lymphatic system and the cornea becomes quite milky, even to the extent of the obliteration of the pupil.

Treatment. — As soon as possible after the burn was received in the cases reported, the whole of the conjunctival sac was douched with the saturated solution of sodium carbonate. In the majority of cases this was done in the plant. The further treatment consisted in instilling three or four drops of 1 per cent. solution of atropine sulphate and when the pupil became dilated a few drops of sterile castor oil. The eye was then covered with a pad soaked in boracic solution and a bandage applied. Further treatment consisted in washing out the eye night and morning with boric solution and once in twenty-four hours instilling a few drops of sterile castor oil into the sac.

Before leaving the treatment of acid burns it may be useful if I shortly summarize the points I consider important, and at the same time explain the general principles on which the treatment is based. An acid progressively destroys the tissue so long as it is potent and only ceases to act when its corrosive property is destroyed. The more quickly you get rid of surface acid and the more thoroughly you render the acid in the tissue inert by neutralizing it, the more you limit the ultimate damage done. The cicatrix left after healing is in

direct proportion to the amount of tissue destroyed, and I need scarcely add that in the case of the face and eyelids this is a matter of great importance. The thorough cleaning of the burned area and its surroundings are steps taken to prevent sepsis with its attendant danger of absorption and systemic poisoning, the production of weak tissue in healing and the formation of a dense and more unsightly cicatrix.

In the dressing of the wound the substance used should be antiseptic and as little irritating as possible; it should not be oily in character nor should any greasy substance be applied to the skin surface. Pain is better dealt with by local application if possible, and the use of narcotics should be restricted to very severe cases. Picric acid is an ideal substance; its action in precipitating and combining with the albumin of the tissue forms a covering which is antiseptic and protective and at the same time allays pain. It has a property like that of carbolic acid in finding its way into the deeper tissue and acting there. I prefer to use it as a gauze and not as a solution painted on the surface. Its action is really on the same principle as the French substance, ambrine, in sealing up the surface of the damaged area with an antiseptic layer. In the case of ambrine, it is essential to dry the surface. Otherwise, the temperature at which it is applied in the presence of moisture will scald the tissue. At the stage in the treatment of acid burns where the tissue has been soaked with an alkaline solution to neutralize the acid, it is not possible, nor is it desirable, to attempt to dry the surface, and for this reason I think a better result is obtained from picric acid, which can be applied at a safe temperature. The final results of the picric acid treatment are very satisfactory and it is rare to have to graft skin. I have not seen any cases where cheloid developed in the cicatrix. In several of the cases where eyelids were affected, a plastic operation to relieve conditions like ectropion has been necessary. In the treatment of eye cases, I find that atropine relieves pain quite as much as cocaine, and has the advantage that its dilatation of the pupil is more lasting.

SOME INDUSTRIAL EYE AFFECTIONS*

JOHN C. BRIDGE, F.R.C.S.E., D.P.H.
His Majesty's Medical Inspector of Factories

THE lighting of factories and workshops in Great Britain was considered by a departmental committee which, after hearing evidence and carrying out investigations, issued their report in 1915 and recommended standards for efficient lighting (1). These standards have not yet been adopted, but the importance of good lighting for this class of building is undoubtedly receiving greater attention, not only on account of the harmful effects bad lighting may have on the eyes of the workers, but also because of the improved work, greater output, and lessened fatigue which necessarily follow lighting in its best form. So far, however, progress is slow and is largely confined to new buildings; to those familiar with industry, examples of lighting, bad in quality, quantity, and direction, are still innumerable. Not uncommonly a worker is found with his back to the light, using a poor artificial light where, by some rearrangement of his work, sufficient and good light could be obtained from a window.

A recent case seen by the writer also illustrates how actual economy can be effected by considering the question of satisfactory lighting. A man was found working at a sand-blasting cabinet, illuminated by an electric light placed within it. The cabinet was situated beside a large window so that the light from it was directed across the worker's eyes, thus preventing him seeing his work. To obviate the glare from the window the workman had covered it with sacking, brown paper, etc., making the room dark and the use of electric light in the room necessary for general illumination. As the cabinet was firmly fixed, the remedy was to fix a shield or "blinker" on the side of the cabinet towards the window. The removal of the window obstruction not only let in light and air, but also economised the electric light which previously was burning all day.

When educationalists realised that educational establishments, while educating, need not cripple the student, attention was given to the importance of proper lighting of the classroom. The time is not far distant, we hope, when the same consideration will be shown to the eyes of the industrial worker.

It is impossible to estimate to what extent the absence of proper lighting has affected the eyes of workers by producing or increasing refractive errors. The economic benefits of good lighting are, however, so obvious that figures are hardly necessary — if they could be obtained.

Apart from errors of refraction, eye strain and fatigue produced by bad lighting in factories and workshops, there are other definite diseases of the eye caused by certain forms of employment, and the object of this article is to summarise briefly some of those of interest.

Conjunctiva

Hyperemia of the conjunctiva is very frequently seen in workers exposed to acid fumes. Those most affected are men employed in the manufacture of the mineral acids, particularly hydrochloric acid. Exposure to the fumes of acids in other branches of the chemical trade — for example, the manufacture of dyes and their intermediate products — also gives rise to this condition. The halogen group, chlorine, bromine and iodine, produce a similar

* Received for publication July 20, 1920.

hyperemia, but the less frequent use of them makes such cases less common. Ammonia if present in any quantity in the atmosphere similarly affects the conjunctiva.

Acute inflammation of the conjunctiva is less frequent but may be caused by any of the substances mentioned above if the exposure is long enough or the concentration of the gas in the air high. Men employed in patent manure works, digging out the dens or pits, suffer from conjunctivitis caused by hydrogen fluoride, and etchers on glass are affected by the hydrofluoric acid used in the process. Hydrogen sulphide is stated to have been one of the causes of inflammation of the conjunctiva in the manufacture of matches from sesquisulphide of phosphorus (2), and the same gas is probably, to a large extent, responsible for this condition observed among sewer men.

In the dyeing industry, where sulphur dioxide is used, a similar affection has been observed, and Rambousek states in regard to this gas that even in low concentrations in the atmosphere it produces inflammation of the eyes (3).

Naphtha used as a substitute for alcohol in wood polishes has been known to give rise to the same condition, though workers employed spreading cloth with rubber dissolved in naphtha for the purpose of waterproofing and using large quantities daily have not been observed to be affected. Smarting and lachrymation does occur, however, on first entering a workroom where this work is in progress. The fumes from methyl alcohol used in denaturing spirits give rise to the same symptoms and in severe cases to conjunctivitis. Numerous severe and acute cases of conjunctivitis occurred during the war among persons employed in the manufacture of shells and in filling shells with chemicals — the chief of which was di-chlor-ethyl-sulphide — the fumes from which were specifically intended for this purpose. This cause, it is hoped, may be now regarded only as of historical interest.

Acute conjunctivitis is also caused by the light from the arc formed in electric welding, such light having an excess of ultra-violet rays. In these cases the exposure need only be equivalent to a flash if received close enough. The symptoms, which are severe, are fortunately merely temporary and commence some six to eight hours after exposure, the sensation of sand in the eye being the earliest; the pain, photophobia and lachrymation which follow are intense and are generally accompanied by headache. Remedial measures on the usual lines — cold applications with protection from light — are generally sufficient to give relief; aud for the subsequent inflammation a mild astringent lotion is useful. Tinted glasses consisting of a ruby between two blues are necessary in order to protect the eyes, while screens to cut off flashes from the sides are also required. Acetylene welding, though giving rise to a bright light from which it is necessary to protect the eyes of the workers by blue or smoked glasses in order to prevent fatigue, does not produce an inflammatory condition, and in a worker with normal vision no after-effects have been observed beyond "eye tiredness." It is obviously desirable that workers exposed to such lights should be submitted to a preliminary eye test in order to determine the presence of errors of refraction which would increase the strain, but no special test can be employed. In this connection, the increasing use of one-half-watt lamps in factories, the unshaded light from which produces hyperemia of the conjunctiva, calls for comment.

Dust from a large number of chemicals causes inflammation of the conjunctiva by reason of the irritative nature of the chemical, but fortunately conjunctivitis from this source is not common. The basic aniline dyes are said to be specially liable

to cause injury. Para-nitraniline, used largely for dyes and photographic developers, sets up a very acute inflammation, as does also the explosive tetryl (tetranitro-methyl-aniline). Trinitro-toluene on the other hand, though like tetryl in producing an acute dermatitis, rarely affects the eye. Pitch dust produces severe conjunctivitis, which persists for some days; patent fuel workers and men loading and unloading pitch are principally affected.

Conjunctivitis produced by vegetable dust is practically always caused by mechanical irritation, though the dust of certain woods, notably West African and East Indian boxwood, appears to contain an alkaloid which in itself produces inflammation of the conjunctiva accompanied by severe lachrymation. Certain alkaloids themselves, emetine in particular, cause conjunctivitis among those preparing them for medicinal use. Two cases have come under notice of a peculiar susceptibility to linseed meal in oil-cake mills. In these patients the conjunctiva rapidly became suffused, pain and lachrymation were intense in one case, and the symptoms persisted for some days accompanied by coryza. Fresh entry into the mill on recovery produced a similar train of symptoms.

Mercury and silver fulminate both set up inflammation of the conjunctiva, the former causing inflammation of a severe character. Several outbreaks of severe conjunctivitis occurred in a factory where percussion caps of fulminate of mercury were being manufactured. This type of conjunctivitis is accompanied by pain and profuse lachrymation. Strict attention should be paid to personal cleanliness and the workers should be supplied with separate towels; while bathing the hands in a solution of hyposulphite of soda — a very weak solution of which may also be used for the eyes — is also beneficial. In the manufacture of snaps for crackers with fulminate of silver, the inflammation is very much less, but permanent staining of the conjunctiva (argyria) has been observed. In one case seen the employment extended over one year only; in those employed longer the pigmentation was most noticeable, staining of the whole conjunctiva being very well marked, particularly towards the inner canthus. Much of this work is done in small domestic workshops in surroundings where precautionary measures are impossible to enforce, the workers themselves having no very high standard of personal cleanliness. Pigmentation of the skin was also observed. It is probable in these cases that the salt is conveyed to the eyes by contaminated fingers. Women employed in polishing silver articles on polishing wheels also suffer from conjunctival pigmentation, as do men on plants for the desilverising of lead.

Conjunctival hemorrhages have been observed in cases of lead poisoning (4).

It is only necessary to mention the inflammation set up by splashes of acids and caustics into the eye, and the need for immediate treatment in such cases.

Cornea

Certain basic aniline dyes are said to affect the cornea, and in particular the dust of methyl violet which produces inflammation (5). Though strictly speaking the exciting cause of corneal ulceration occurring among patent fuel workers is the injury to the cornea by the spicule of pitch, the extent of the ulceration and the hypopyon which commonly follows must be considered to be due in some measure to the same constituent of the pitch as produces cancer of the skin among these workers. Tar and paraffin workers may be similarly affected. Inflammation and opacity of the cornea are said to be caused by nitro-naphthalene, attributable either to long continued exposure to the vapor or to spurting of the liquid into the eye (6).

Burns from splashes of acids and caustics which produce inflammation and ulceration of the cornea occur wherever such chemicals are handled and call for immediate first-aid treatment.

Retina

The commonest industrial cause of disease of the retina is lead poisoning. Legge and Goadby regard temporary or sudden blindness as due to a vascular change of the retina, either vasomotor or hemorrhagic (7). In advanced cases they state the "picture is one of severe albuminuric retinitis." Dilatation of the vessels has been observed among electric welders accidentally exposed to the light of the arc. Temporary and partial amaurosis is also produced. Retinitis and other eye changes are also described as occurring among this class of workers (8).

Toxic amblyopia, which may be considered under this heading, occurs among workers exposed to dinitrobenzene, those most affected being employed in filling cartridges. A few cases of this nature have been observed among T.N.T. workers but in these it was difficult to eliminate tobacco. The fumes of carbon bisulphide used in vulcanising rubber by the "cold cure" process may also produce similar symptoms. In such cases of amblyopia, the scotoma is central and that for green larger than red, both eyes being equally affected. Recovery usually takes place quickly after removal from the poison. Folker has described five cases of women suffering from amblyopia due to lead. Additional interest in these cases, as he says, lies in the fact that the use of tobacco could be safely excluded (9).

Pupil

The pupil appears to be rarely affected. Among pharmaceutical workers, accidental contact of the hands and eyes during the preparation of atropine salts produces the usual mydriatic effect. Instances of intolerance of the skin to morphia in the manufacture of the salts of this alkaloid are not accompanied by alteration in the pupil. In lead poisoning inequality of the pupil may be observed but partial dilatation of both pupils is more common (10).

Optic Nerve

Neuritis of the optic nerve occurs with chronic lead poisoning. It is usually, if not always, associated with retinitis, and total blindness occasionally occurs. Chronic nitrobenzene poisoning is stated to give rise to optic neuritis (11).

Lens

Glass bottle blowers suffer from posterior cortical cataract. Such workers, it was estimated by Dr. W. Robinson of Sunderland, are exposed to the glare of the molten metal for $5\frac{1}{2}$ hours per week, and it is now generally accepted, after the work on the subject by Sir William Crookes, that the heat given off from the metal is mainly, if not entirely responsible (12).

Several cases of cataract have been observed following accidental electric shock. These are due to the passage of the current through the body and not to the flash which sometimes accompanies an accident of this character (13).

Ocular Muscles

Paralysis of the ocular muscles was noted by Lockhart Gibson in Queensland among children accidentally poisoned by lead.

Nystagmus

Oscillation of the eyeball among miners is a well-recognised condition, the exact causation being at present not fully understood, although imperfect illumination of the coal face is generally regarded as an important factor. Reference must also be made to nystagmus which sometimes occurs in cases of lead poisoning (14).

BIBLIOGRAPHY

1. First Report of the Departmental Committee on Lighting in Factories and Workshops, 1915. (Cd. 8000.)
2. Annual Report of the Chief Inspector of Factories for 1908, p. 199.

3, 5, 6, 11. Rambousek, translated by T. M. Legge: Industrial Poisoning, London, 1913, pp. 171, 119, 116 and 115.

4, 7, 10, 14. Legge, T. M., and Goadby, K. W.: Lead Poisoning and Lead Absorption, London, 1912, pp. 269 and 159.

8. Kober, G. M., and Hanson, W. C.: Diseases of Occupation and Vocational Hygiene, Philadelphia, 1916.
9. Ophthalmological Society's Transaction, **19**.

12. Crookes, *Sir* William: The Preparation of Eye-Preserving Glass for Spectacles. Phil. Trans., Series A, **114**.

13. Van Lint, A.: Accidents Oculaires provoqués par L'Electricité, Brussels, 1909.

HEALTH IN MERCANTILE ESTABLISHMENTS
II. MEDICAL RECORDS*

ARTHUR B. EMMONS, 2D, M.D.
Director, Harvard Mercantile Health Work, Boston, Mass.

THE necessity for records has been discussed in the first paper of this series, but the precise form and the manner of introducing a record system have not been approached.

From the practical point of view of the store administrator, the subject divides itself into two parts. First, there is the question of the physical examination for employment, and, second, the record to be kept of an ordinary visit to the doctor's office. To many stores the policy of introducing a physical examination for employment seems at present inadvisable. They fear difficulties with their employees which may far offset any advantages that such modern methods may supply. There are very few well-organized industries employing large numbers of people who do not first estimate by physical examination the fitness of the employee for the work to be undertaken. It would seem the logical and intelligent policy, therefore, that stores should supplement other employment methods by instituting a preliminary examination of sufficiently broad scope to insure fitness to carry on the varied tasks of the store under the active conditions of city life.

We are personally acquainted with the work of five large stores in the East and Middle West which have been using examinations before employment for periods of from one to eight years. None of these have ever given up the procedure and all have realized its advantages more and more. Investigation shows that employment managers in many other stores are looking forward to the time when they, too, may have assurance from a modern medical department that the applicant is reasonably suited for the job. At present, they must depend on the general appearance and the prejudiced statements of the hopeful applicant, or upon the guarded reference of a former employer.

The practical benefits which the stores using physical examinations report include the steady improvement of their personnel due to better adaptation of the individual to his work, the discovery of serious disabilities, such as heart disease, so that if the applicant is accepted he is safeguarded, the exclusion of early cases of tuberculosis, and the detection of remediable defects, such as hernia, diseases of the mouth and teeth, etc. While the medical examination must result in preventing the employment of a certain number of persons, this has become a minor feature of its work. If the physician has knowledge of the different types of work which the store furnishes, he will be able to suggest places fitting the physical qualifications of nearly all applicants.

Industry presents some interesting examples in this direction. Clark (1) speaking from his experience in the Norton Company (manufacturers of grinding wheels and grinding machinery in Worcester, Mass.), where the restrictive list of defects is rather severe because of the heavy nature of the work, finds that 3.5 per cent. of those applying for work are rejected on physical grounds. Other reports show as high a figure as 10 per cent., but it seems probable that with thorough knowledge of the work of the plant the industrial physician can reduce this very markedly.

Such benefits as have been listed reach

* Received for publication Sept. 27, 1920.

Figure 1

PHYSICAL EXAMINATION

Date .... 192 , ... M.

Name .... Check No. .... Department ....

Nature of Work ....

Address .... Age .... Sex ....

Married .... Children .... Other Dependents ....

General Appearance .... How long in our employ ....

Weight .... Height .... Nationality .... Color ....

Head and Neck: Evidence of previous injuries ....

Eyes: Vision close ....

Vision Distance, Right .... Left ....

Pupils, Size .... Shape ....

Reaction Light ....

Accommodation ....

Use of Glasses ....

Ears: Hearing, Right .... Left ....

Discharge, Right .... Left ....

Tympanic Membrane, Right .... Left ....

Nose: Septum ....

Adenoids ....

Throat: Tonsils ....

Tongue ....

Mouth ....

Teeth, Right 8 7 6 5 4 3 2 1 / 8 7 6 5 4 3 2 1 Left 1 2 3 4 5 6 7 8 / 1 2 3 4 5 6 7 8

Gums ....

Chest: Abnormalities ....

Lungs: Chronic Cough ....

Apical Fields, Right .... Left ....

Sputum .... Temperature ....

Microscopic Examination ....

Von Pirquet Test ....

Heart and Blood Vessels:

Location Apex Beat ....

Rhythm .... Rate .... Blood Pressure ....

Lesions ....

Condition Blood Vessels ....

Varicose Veins ....

Varicose Ulcers ....

Abdomen and Genito-Urinary Test:

Abdomen: L. M. S. .... Visceroptosis ....

Liver .... Spleen ....

Kidneys: Palpability .... Tenderness ....

Urine Examination: Specific Gravity .... Reaction ....

Albumin .... Sugar .... Microscopic Exam.

Hemorrhoids .... Fistula ....

Hernia: Inguinal, Right .... Left ....

Femoral, Right .... Left ....

Umbilical ....

Genital Organs: Gonorrhea, active ....

Syphilis, active ....

Syphilis, history of .... Date ....

Chancroid ....

Hydrocele ....

Varicocele ....

Constipation ....

Diarrhea ....

Fits ....

Epilepsy ....

Fainting Spells ....

Muscular System:

Pain or restricted motion ....

Atrophies ....

Glandular System: Thyroid

Inguinal .... Cervical ....

Axillary ....

Cubital ....

Spine: Scoliosis .... Kyphosis .... Lordosis ....

Extremities: Flatfoot: Right .... Left ....

Deformities or physical defects ....

Vaccination ....

Amputations ....

Skin Disease ....

Reflexes .... Equilibrium ....

Habits: Liquor .... Yes .... No ....

Tobacco .... Yes .... No ....

Mentality: Bright .... Average .... Dull ....

Movements: Active .... Average .... Slow ....

Serious Operations, Illnesses and Injuries:

General Remarks and Recommendations:

Class ....

Examining Physician:

but one side of the question, and it is essential to realize that each large move in industrial medicine must have two results. It must aid the firm, and at the same time it must aid the employees. Lacking either of these advantages, the move does not contain those honest elements which make for certain success. The attitude of labor in general toward physical examinations as a condition for employment has, in the main, been unfavorable. It will be remembered that one of the demands made during the steel strike of 1919 was the abolition of such examinations, the employees holding that the examination as then conducted was unfair to their interests. There is, however, abundant evidence that labor recognizes very fully the great advantages which thorough and fair medical service can supply. Thus, the organized garment trades in New York now require an extremely searching physical examination for admission to the union (2). An action such as this indicates at once that in the organization of a medical department in a store or in an industry of any type, effort should be made to give the employees a voice in the general control of the department, and in this way to cause removal of the possibility for discrimination, unfair use of records, etc., which the employees fear.

Figure 2

Medical No.........................

PHYSICAL EXAMINATION

Dental No. ....

Employment No..................

Date ....

Name.. Age.............................. Sex ....

Dept.. Height.............................. Weight ....

Position.. Previous Occupation...............................

Nutrition.................................... Anemia.................................... Tonsils ....

Bad Cough.................................... Glands .... Teeth .... (See Dental Chart)

Hearing.................................... Sight R..............L.................... (Good, Fair, Poor) Goiter ....

Heart.................................... Lungs.................................... Hernia....................................

Blood Pressure.................................... Hemorrhoids.................................... Urine .... Albumin—Sugar

Operations (Age).................................... Previous Illness (Note details on reverse side)....................

Remarks or Additions:

....

....

....

The character of the physical examination for employment varies markedly in industry. Figure 1 represents a form used in a large meat-packing establishment. It is obviously so long and complex that a great amount of time is required to fill it in carefully, and unless such record forms are adapted to the need they should fill and to the time which can be given to each candi-

Figure 3

MEDICAL EXAMINER'S REPORT

Rate of pulse	Posture	Does it intermit or become irregular?	Cause?
Character	Feet	Measurement of Chest: Inspiration	Abdomen at umbilicus
Height	Weight	Expiration	
Race	General Appearance	Blood pressure	
		Arteries palpable?	

After careful inquiry and physical examination do you find any evidence of past or present disease of:

Lungs or Pleurae

Brain or Nervous System

Heart

Blood Vessels

Skin

Nose and Throat

Stomach or Abdominal Organs

Gained or lost any weight in past year

Condition of teeth

Is hearing impaired?

Is eyesight normal?

Is hernia present?

Has he the mark of a successful vaccination?

REMARKS

Urine Examination

Specific gravity .... Reaction ....

Albumin? .... Sugar? ....

Questions to be Answered if Applicant is a Woman

Married or single? .... Is husband living? ....

Is she pregnant? .... No. of children living .... Age of eldest .... Age of youngest ....

No. of children dead ....

Has she ever had a miscarriage? .... Has she since had labor of full term? ....

Has she passed the climacteric? .... When ....

Is menstruation regular? .... Pain? .... Reflex symptoms? ....

Signature .... M.D. Address ....

Medical Examiner

FIGURE 4

Accepted

Rejected

Accepted provisionally?

History No. ....

Date..........

Name of Applicant	Address	Department

Age	Place of Birth	How long in New York?

		AGE IF LIVING	STATE OF HEALTH	AGE AT DEATH	CAUSE OF DEATH	DURATION OF FATAL ILLNESS	
Father							To what extent does he use stimulants?
Mother							
Brothers	No. Living						To what extent does he use tobacco?
	No. Dead						
Sisters	No. Living						Other habits?
	No. Dead						

Have any of the applicant's uncles, aunts, or grandparents had insanity, cancer or tuberculosis?..........

Has he within one year occupied same room or house with a consumptive?..........

What physician did he last consult.......... When.......... For what.......... Duration of illness.......... Present health..........

What illnesses, diseases, accidents or surgical operations has he had since childhood?..........

Name of Disease, etc.	No. of attacks	Date of each	Duration	Severity	Results	Date of recovering

Signature..........

date for employment, they are worse than useless. Figure 2 is a form used by a large manufacturer of electric lamps, a firm employing many thousand men and women. It is brief but contains the essentials and may be filled in rapidly. Figure 3 is an example of a form now in use in a large department store. It is a very good one and possesses on the reverse side the medical history sheet shown in Figure 4. It seems probable that this store requires more than is necessary to gain good results.

After examining the store situation and bringing to bear upon it such elements of industrial medical experience as seem pertinent, we have designed the brief form shown in Figures 5 and 6. This may be made up on a 5 by 8-inch card. On the front are contained the necessary social data, occupational data, important past medical history, and recommendations to the employment department; on the back are the points covered by the physical examination. Such cards may be filed and to them may be clipped others of similar size upon which are recorded subsequent visits to the physician's office, their cause and treatment. The record kept of such visits should be as detailed as the condition warrants. A word or two will frequently suffice, but unless a rigid rule is made that no visit shall go unnoted, it is certain that sooner or later the store physician will awake to the consequences of having seriously neglected to notice the advance of chronic disease.

The technique of introducing the methods of a modern medical department in the store may be varied. If a decision has been reached to institute physical examinations for employment, due publicity should be given and the plans for work made clear to everyone involved. First, the executives should be informed and their approval and co-operation obtained; then the buyers, departmental heads, and supervisors should clearly understand the plans. Finally,

FIGURE 5

PHYSICAL EXAMINATION

Date of Examination ....

Weight .... Height .... Vaccination ....

Inoculation ....

Skin ....

Head ....

Eyes, R. .... L. ....

Ears, R. .... L. ....

Nose .... Throat ....

Teeth .... Neck and Glands ....

Chest .... Heart rate .... Size ....

Sounds .... B.P. ....

Lungs ....

Abdomen ....

Pelvic ....

Extremities, Upper .... Lower ....

Feet .... Posture ....

Reflexes ....

Urine .... Blood ....

Comments:

General Appearance ....

Apparent Age .... Temperament ....

Peculiarities ....

Examined by ....

through the store paper or through a special bulletin, a concise and clear statement should be made to all the employees and, if an employees' organization exists, the fact that the medical department will be under a co-operative board of control should be especially emphasized. After all this has been done it will be found that success depends upon the personality and training of the physician in charge, and the qualifications which he or she should possess have been made clear in the first paper of this series.

Should the store desire a less vigorous course than this, it may well start by first requiring physical examinations of all food

handlers and elevator operators, for public safety is here directly involved. Next offering free examinations will bring volunteers. The character of the work done will then determine its success and scope. If, at first, attendance at the doctor's office falls off, no uneasiness need be felt. The success of the medical department depends far more upon the excellence of the work done than upon any other feature, and, given efficiency in this direction, the matter of attendance will soon take care of itself.

FIGURE 6

....Store

Name..Address..M. or F., S.M.W..............

Age ....

Occupational History	Recommendations to Employment Dept.. ....
Past Medical History..	

BIBLIOGRAPHY

1. Clark, W. I.: Physical Examination and Medical Supervision of Factory Employees. Boston Med. and Surg. Jour., 1917, **176**, 239.

2. Price, G. M.: Industrial Medical and Dental Clinics in the Women's Garment Trades. Mod. Med., 1919, **1**, 47.

A STATISTICAL STUDY OF ACCIDENTS IN THE COTTON MILLS, PRINT WORKS AND WORSTED MILLS OF A TEXTILE COMPANY*

DONALD S. GATES

Student, Graduate School of Business Administration, Harvard University

THIS paper deals with the statistical determination of the modes of occurrence of about 2500 accidents in a large textile company in New England, covering the calendar years of 1918 and 1919. The business of the company in question is the manufacture of cotton and worsted cloth, and the printing of cotton cloth. The company employs about 7500 people. The material for the study was compiled from the company's accident reports — reports made up in accordance with the provisions of the Massachusetts Compensation Act of 1911. Owing to the large number of accidents involved in the study, limits were made to the extent of the analysis as follows:

1. The recorded facts of the accidents were divided into groups:
   a. Hour of day of occurrence
   b. Day of the week
   c. Day of the month
   d. Age of the injured
   e. Sex of the injured
   f. Married or single
   g. Wage of the injured
   h. Time or piece rate
2. The lost-time accidents during 1919 were separated by departments. There were 213 cases of this sort.
3. The total of 2500 accidents was separated by departments.
4. An analysis of the results of this tabulation was made, methods of presentation of the tabulation to the groups interested were discussed, and a procedure for applying practically the results of the analysis, together with the organization for carrying them out, was outlined.

* Received for publication April 15, 1920.

The organization of the plant studied is as follows:

1. The print works is made up of twenty-four departments, which include the bleaching, dyeing, finishing and printing of cotton cloth. It is entirely separate from the other parts of the company's plants. About 2300 employees are on its payroll, this number being about 34 per cent. of the total in all of the mills. Of this number, about 1750 are male and the remaining 550 are female.

2. The worsted department is a separate division. The manufacturing process includes all operations from the raw wool to the weaving of the finished product. The employees number about 2800, with 1500 females and 1300 males.

3. The cotton department is also a separate division, but with transportation facilities closely allied to the print works. Here, out of a total of about 1200 employees, there are 650 females and 550 males.

4. The purchasing department is the necessary yard force and all of the transportation facilities among the various plants. This transportation is carried on by means of motor trucks. There are in this department about 400 employees, of whom 350 are males.

Classification of Accidents by Accompanying Circumstances

When an accident occurs, the Compensation Act requires that eight facts in regard to the circumstances of the accident and of the injured person be noted — namely, the hour of the day, the day of the week, and the day of the month on which the acci-

dent occurred, the age, sex, and marital condition of the injured person, his wage, and whether his work was time or piece work. When these facts are studied in connection with a large number of accidents, does a frequency-of-occurrence curve result of any practical value?

A. *Hour of the Day.* — From the figures in regard to the hours of accident occurrence the most striking frequency curve of the entire investigation is obtained. The accidents occur most frequently in all departments at the hours of 9 A.M. and 3 P.M. The question at once arises: What are the factors that would offer a solution? There are, first of all, the physical ones. These include:

1. The number of employees in the plant. Obviously there is no difference between these hours and any other working hours in the matter of number of employees.
2. Machines in operation. There is no reason to believe that there is an increase in the number of machines in operation during any particular hours.
3. The speed of the machines. There is no increase in this particular.
4. There is practically the same amount of sunshine at these hours during all seasons of the year.
5. The periods are equidistant from the last time food was taken. Of all the physical facts, this one is the most striking and will serve well to introduce the second set of factors which may offer a solution; i. e., the physiological ones.

The physiological factors are:

1. The physical condition of the employee at the time of the accident. Fatigue and its connection with the food-taking period produces a mental condition, dependent upon the physical one.
2. The age of the injured employee.
3. The sex of the injured person.

In order to discuss this question thoroughly, it will be necessary to anticipate the later sections of this report enough to say that the commonest age for the accident-person is 18 years and the predominant sex is male. Taken together, these facts as brought out by this inquiry lead up to the question: How does it happen that accidents occur most frequently to an 18-year old boy, at the hours stated above? For it is but reasonable to suppose that if this "peak man" can be dealt with, a real solution is possible.

The "peak man" is a person who is not only young, but has the most striking characters of quite immature youth. Such characters are a general mental attitude of carelessness and a very natural aptitude to be sleepy after eating. It is here that a difference of opinion will enter in. It is a question in my own mind as to whether this accident occurrence is due to carelessness from a certain mid-morning and mid-afternoon drowsiness or to the fact that that low mental period is passed and the fastest work of the day is being done. In either case there would occur a high accident rate, for were it a case of drowsiness, fingers would not be so swift to move out of danger as in the other periods of the day, or if it were a case of high speed work, coupled with the youthfulness of the employee, a willingness to go on with the work and "take a chance" on getting hurt might produce injuries. There is a good deal to be said, I think, for the idea that, especially in the morning, the high-speed work is the cause of accident. By high speed I mean the fact that the employee is working at his fastest rate and is doing everything that the task requires, whereas later the little niceties of the job are left to the realm of "I guess that will do." There is more attention to the more complete handling of the work in the freshness of the morning than there is later on in the day. And at the same time there goes with this completeness of work a closeness to the machine and its parts which would have more possibilities of accidents.

Granting that the after-dinner feeling does not extend till 3 o'clock, there would come a period of extra energy at this hour due to the very fact that a period of slow work had just preceded it. The accident hour at this time may represent an attempt to make up for the slow work done just previously.

In many parts of the textile industry, there is involved the work of supplying raw material for a machine which operates continuously. During a period of drowsiness, there would be a temptation to let the entire raw material for the machine run to a low point, with the result that a time of extra fast work to restock would be required. Take, for example, the four machines — a spinning frame, a loom, a worsted comb and a drawing frame — the operation of each of which is a continuous process. What would be more natural than for a drowsy operator to let the raw material supply "slide" for a longer period than usual after lunch and then have to be very active to fill up the frame? And in the loom, the question of supplying new bobbins would be put off after lunch for as long a period as possible.

Summarizing, it is my opinion that the theory of the high-speed cause for accidents will hold better for the morning than for the afternoon, but for reasons given above I should apply it to both times. In the afternoon, moreover, natural fatigue may more easily operate than in the morning.

B. *Day of the Week.* — The most striking fact brought out by a study of the day of the week upon which accidents occur is the large proportion of accidents during the forenoon on Saturdays. The average daily accident rate is 449 with a half-day average of 224+. But the half-day on Saturday shows an average of 265 accidents, which is 18 per cent. above normal. There are various factors which might influence this result, among these being the peculiar nature of the work done on Saturday, the mental processes of the employee so full of the plans for the afternoon that a natural carelessness would result, a rush to finish the week's work, and the necessity for cleaning and clearing of machines.

C. *Day of the Month.* — The chief fact brought out by this tabulation is of interest to the textile company studied rather than to the general public, and consists in the increasing accidents reported after July 1, 1919. This result is due to the emphasis placed by the safety engineer on the slightest injury in order to catch early accidents which have possibility of further trouble, such as infection from scratches. As safety work rests on the theory of accident prevention, it is essential that prevention start at the source of the trouble and that an injury be caught when it is still a minor one.

D. *Age of the Injured.* — The high mark of frequency is at 18 years. This fact is especially valuable as showing the youth of the injured and placing the greatest emphasis on accident prevention on this type of person. Were the figures available, it might be shown that one of the reasons for this "peak age" was the fact that of all of the employees in the plants the greater number were of this age. But even if this were the case, it is still of importance to know that so young an employee is the bearer of the greater accident risk.

E. *Sex of the Injured.* — Nearly 80 per cent. of the total accidents happened to males. Against this fact must be set the percentage of males in the plant. The figures and percentages are as follows:

Sex	First Part of 1918	Last Part of 1918	March, 1920
Males	4369....64%	4799....62%	4718....61%
Females ...	2352....36%	2926....38%	2922....39%

The peculiar nature of the industry has a good deal to do with these figures. The

women are employed in the parts of the mills where the lighter work is done. The men are employed where the more cumbersome machines are operated. The loom fixers, for instance, are men, and the work is done around the more crowded parts of the machine, often when the machine must be turned off and on. In general, considering the nature of the men's work it is no wonder that upon them falls the greater part of the injuries. The knowledge of this fact merely emphasizes the necessity for watching more closely those operations where men are largely employed and seeing that their machines and processes be more carefully and thoroughly studied with a view to eliminating as far as possible the accident risk.

F. *Married and Single.* — The figures upon this fact are nearly equally divided, a slightly greater number of injured persons being married. This is one of the main reasons for the benefits of the compensation act — to serve as a safeguard for the family during the enforced idleness of the injured husband or father.

G. *Wage of the Injured.* — Here the modal peak falls on the $18 man. The main question which might be raised in this connection would be in the application of the compensation act. With the working wage in such times as these only $18, what percentage of this wage had better be paid as compensation for lost time? Eighteen dollars per week represents a round sum of $900 per working year. How much less than this should be guaranteed in case of failure to be able to work? It would seem that at least two-thirds of this wage should be paid, if not three-fourths, in order to insure a reasonable income during disability.

H. *Time and Piece Work.* — The greater portion of the work in the mills, as shown by the compilation, is done on a straight time rate. This at once removes as a cause of accidents rush work being done on piece rates. Nothing of special value is to be learned from the figures on time and piece work. In a more detailed special inquiry, it might be well to have the accident frequency at some of the piece-rate machines charted.

This concludes a summary of the data obtained from classifying the eight facts in regard to accidents required by the compensation act. What, in the main, have been the outstanding benefits derived from this tabulation of about 18,000 facts as noted in the accident reports? We have learned that out of this group of accidents, each of which was apparently totally independent of the other, there appear certain more or less striking similarities in the circumstances surrounding them. In other words, we have become orientated for further inquiry. Methods of attacking the peaks of accident occurrence may differ, but it is clear that there must be agreement in the goal sought for.

Whatever the cause of accidents, undoubtedly one of the best ways to attack the problem of their prevention is to present the facts clearly to the operators and to arouse their interest in the problem. This should be done through verbal and picture instruction. Nothing lends itself to graphic presentation better than this matter of accident frequency. The facts of accident occurrence may be presented either in the form of a straight bar chart or in the better form of a frequency curve on a clock base. Perhaps in this connection I had best say a few words as to the general policy of presenting graphs to great numbers of employees. In the first place the graphs must be striking. The eye will not take cognizance of a small difference. This point is well illustrated by the use of a graph presentation of the hourly accident rate and the daily accident rate. In the former case, there is a wide difference in the number of accidents which causes the hours to be marked off clearly, while in the latter

case there is at best only a little less than one-fifth difference in length of the two average bars. A frequency at least double the other frequencies presented should be present to justify the use of a graph. In the second place, a graph should be simple. It should contain the minimum of subjects and the lines should be clear cut and not mixed or crossed too often by other lines. Popularity will lie along this same line of simplicity. A graph using hours of the day should be made up in the form of a clock. Graphs of temperature should be modeled after a thermometer. Two graphs, moreover, should rarely be shown together. The mental picture which results, like a photographic plate duplication of objects, is apt to blur.

TABLE 1. — COMPARISON OF PERCENTAGE DISTRIBUTION OF ACCIDENTS IN THE TEXTILE INDUSTRY WITH ACCIDENTS OF INDUSTRY IN GENERAL

		2500 Accidents in Textile Industry	Mass. Accident Board
Sex of the Injured	Male	79	91.3
	Female	21	8.7
		100%	100%
Time or Piece Work	Time	88.3	86.7
	Piece	11.7	13.3
		100%	100%
Wage Distribution	Up to $8	0.4	6.7
	$8 to $15	18.5	55.8
	$15 to $20	53.1	24.5
	Over $20	28.0	13.0
		100%	100%
Age Distribution	Under 16	6.7	1.8
	16–20	15.8	13.3
	21–29	25.9	33.9
	30–39	20.3	23.7
	40–49	17.4	15.7
	50–59	9.6	8.3
	Over 60	4.3	3.3
		100%	100%

In the *Fifth Annual Report* of the Massachusetts Industrial Accident Board, for the year ending June 30, 1917, the percentage distribution of total accidents is given by groups. For purposes of comparison, I have drawn up a similar distribution of the accidents entering into this study (Table 1). In a comparison of these figures, it must be kept in mind that in the textiles we are dealing with one special industry and are comparing its figures with the percentages drawn from general industry. If for no other reason but for emphasis on the special characteristics of the textile industry, these figures are of value.

The character of the textile industry is shown especially well in the first and last comparisons in Table 1. The percentage of females is considerably higher in the textiles than in general industry, as the percentage of accident occurrence shows. Also the percentage of young persons is higher in the textiles than in other industries, as shown by the differences in percentages of those under 20 years in the above figures. The shift in the wage distribution groups is caused by the general rise in the rate of wages during the last two years. For the greater part, there seems to be a system of day wages in the textiles as in any other industry, or, speaking from an accident point of view, the number of accidents due to speed caused through a piece rate are no greater in the textile industry than in any other.

Occurrence of Accidents by Departments

In this section comparisons will be made between the lost-time accidents and the total accidents, both of which have been divided and allocated by departments. In the tables submitted with this section, a graphical presentation of the accident occurrence is shown, but for purposes of the greatest utility only those departments showing the relatively highest accident rates will be discussed. For it has been a principle of this report to deal only with the occurrence and treatment of the peaks

of the accident problem. In this discussion the purchasing department will be omitted as it is a single and special department in itself and entirely independent from the more technical industrial processes.

In the table which is given below (Table 2) the top accident departments are selected for examination. From these figures some idea of the relation between the lost time and the total accident rate may be gained. The italicized names appear among the highest rate accident departments in the figures both for lost time and for total accident occurrence. Of the seventeen names on this list, seven appear in both columns. There is a total of fifty-six overseers in these plants. If the accident rate were the same for each overseer, with an average of 2500 accidents and 213 lost-time accidents, each overseer would have as his rate 3.5 lost-time accidents and 44.5 total accidents. This compilation shows how much above this hypothetical rate the "high peak" overseers average. Out of 2500 accidents, these seven overseers had in their departments 771 accidents. Numerically stated, this means that one-eighth of the overseers had one-third of all of the accidents. In the same manner, these overseers had a little less than one-third of all of the lost-time accidents.

What is the nature of the work in these departments to cause such a high accident rate? To aid in this answer, these departments may be grouped as follows:

Worsted	Through drawing (Walden)
	Repair (James)
Print Works	Repair (Jackson)
	Printing (Albee)
Cotton	Through roving * (Simmons)
	Spinning (Brink)

This grouping shows certain rather striking facts. In the case of cotton manufacturing, the groups show that whatever methods of accident prevention have been adopted, there is still a great deal to be done. For in cotton, the accident frequency is greatest in the industry throughout the entire manufacture of the spun thread.

TABLE 2. — CLASSIFICATION OF ACCIDENTS BY DEPARTMENTS

Lost-Time Accidents		Total Accidents	
Worsted Mills			
Walden	13	*Walden*	116
James	8	*James*	158
Hastings	13	Sturgis	90
Noble	7	Childs	81
	41		445
53.9% of lost-time accidents in worsted mills		47.4% of total worsted mills accidents	
Print Works			
Jackson	8	*Jackson*	142
Kingman	8	*Kingman*	70
Albee	6	*Albee*	122
Shaw	7	Atkinson	81
Taylor	6	Burns	93
	35		508
42.6% of lost-time accidents in print works		43.1% of total print works accidents	
Cotton Mills			
Brink	10	*Brink*	80
Simmons	10	*Simmons*	83
Rowley	9	Warner	63
	29		226
51.7% of lost-time accidents in cotton mills		57.8% of total cotton mills accidents	

This series of processes includes the entire machine list up to the looms.

In worsted manufacture, the fact of the longer staple of the raw material may influence the accident rate. The fact that there are less interruptions to the process of manufacture due to a breaking of the fabric in its passage through the machines will probably be responsible for the less degree of risk in the spinning process as compared to the cotton.

The fact that the repair department should appear twice is more easily explained. This department is a peculiarly risky one due to the fact that it is work

* Through roving means that these departments include all the processes from the picking and carding machines in the manufacturing process to the time when the material is presented to the spinning machines.

demanding much closer association with machines out of order, and where the risk arising from accidental starting and stopping of the machines is greater. The men in these departments are constantly doing work on the more complicated parts of the machines, work requiring frequent starting and stopping of the machines to determine whether or not the repairs are satisfactory. Moreover, a greater number of machine tools are being handled in these departments than elsewhere.

In the printing process, there are two major causes for the higher accident rate. One of these is the "doctor-blade," an instrument used in connection with the printing machine which has an unduly large number of accidents. This blade is a long one used for scraping off the surplus of color from the copper rolls as they turn against the print cloth. This blade is very sharp and requires frequent sharpening by a hand method. In running over a list of the accidents in the print works, I am surprised at the number of reports which state that the employee was cut on this blade. The process of sharpening is identical with the ordinary method of a boy sharpening a jack-knife, but here the blade is much sharper and at least 36 inches long. The smoothing off process after the actual sharpening is particularly conducive to accidents because of the danger from cuts when the sharp edge of the long blade is rubbed with the smoothing cloth.

In this discussion of the reasons for accident disposition I have not attempted to cover all of the causes of accidents, but I have attempted to bring out the most salient features of accident occurrence in the textile industry. The main purpose of this study will have been achieved if the engineer has been guided in his work to the important points of attack in the reduction of accident occurrence. For at this point, the work of the statistician must end; actual accident prevention is a process of safeguarding machines against the possibility of accidents, and this is the engineer's task.

INDUSTRIAL "GASSING" AND THE EDWARD MEDAL*

THOMAS M. LEGGE, M.D., D.P.H.
His Majesty's Medical Inspector of Factories

WE have been thrilled during the war by deeds of bravery done by the highest and lowest in the army, and no less do those who know the risks run by workers in munition factories at home stint praise of the presence of mind, courage, and self-sacrifice shown by workers in attempting to extinguish fires or prevent explosions, or in risking health in the service of their country. This, however, is no new thing; and when I look through the reports on cases of poisoning by fumes and gases, I am always carried away, as in the reading of a romance, by the excitement of the event, the tangled thread of circumstance which has brought the situation about, the attendant sins of omission and commission, and I breathe a sigh of relief or feel a lump in the throat, as success or disaster attends the effort at rescue.

When we talk in cold blood about workers, reference is sometimes made to traits of weariness that come over them, as evinced in limitation of output. We speak of "Weary Willies" and of a "Ca' Canny" policy. But where a workman's life is in danger, I have yet to read of any fellow worker shirking the effort at rescue, or even hesitating to risk his own life in the attempt. The scenes thus visualised carry the mind's eye to high gantry stagings — the feeding places on the tops of blast furnaces — to cleaning operations inside retorts — acid eggs — tank wagons, access to which has to be gained through manholes so small that a man must squeeze his body to pass through, to dark underground passages in the mine where, crawling on his hands and knees in mephitic atmosphere, and running in danger from falling roofs, the rescue party slowly makes its way. The whole atmosphere around these gassing cases is tense in the highest degree. Even the language in which the inspector describes the occurrence has in it something of the knell of fate:

> During salvage operations on board the steamship *Great City*, the holds of which the men knew to be heavily charged with gas arising from decomposing grain, one of the stevedore's men noticed some pieces of wood floating towards the pump and, contrary to strict orders, went down to pick the wood up so as to prevent the pump from choking. While in the act of doing this, he was overcome by gas and fell into the water. Anderson, who had some time previously suffered from gas poisoning, and therefore knew the gravity of the risk at once went to his assistance and succeeded in holding him up while a rope was being sent down to him, but before this could reach him he was also overcome and fell into the water. Tierney and Gab then went to the rescue, but both were also overcome. Anderson, Tierney and Gab undoubtedly lost their lives in an endeavour to save the lives of their fellow workman!

The following are instances of the dramatic nature of carbonic oxide poisoning, of which the symptoms are so insidious — almost the first effect being to rob the workman of the use of his limbs:

> A man named Heald descended into a melting furnace 30 feet high in order to adjust a piece of scrap iron under which some coke had to be placed. Heald descended into the furnace by a chain, and was immediately overcome by noxious gas which had collected there. A man standing at the top at once gave the alarm and Shadrach Jackson and Ince came to his assistance. Jackson without hesitation slid down the chain, and a rope was thrown to him, which he tied round Heald, who was then pulled up, Jackson climbing up the chain after him. As Jackson, however, reached the door through which Heald was being pulled he too was overcome by the gas and fell back to the bottom of the furnace. Ince then descended and placed a rope round Jackson's body, but unfortunately it slipped off before the men could

* Lowell Institute Lecture, delivered in Boston, Mass., Dec. 4, 1919. Received for publication Feb. 1, 1920.

be pulled out, though Ince, feeling that he was overcome by the gas, climbed up the chains and escaped. On recovering, Ince went down a second time, once more tied the rope round Jackson, but again failed to bring him to the surface, though he himself escaped by a ladder which had been brought. At this, Darley then went down the ladder with a rope, which was attached to Jackson's belt, but unfortunately the belt gave way. On Darley coming up, Speke went down, and the rope being more securely tied round Jackson's body, he was extricated, though unhappily, on reaching the surface it was found that he was dead. All the men were fully aware of the risk to which they repeatedly exposed themselves.

How could those men have known that one of the first effects of carbonic oxide gas would be to rob them of the use of their limbs, and how comes it that no mention is made of the use of a safety helmet or mask?

Every year carbonic oxide gas claims more victims than any other gas in factories and workshops because of the wide extension its use has undergone in the manufacture of water gas, and of other gases of a similar nature — suction gas, Dowson gas, Mond gas, power gas, producer gas, and blast furnace gas for driving gas engines, heating furnaces and boilers, welding, soldering, and other industrial purposes. Whereas the proportion of carbonic oxide in coal gas varies from 4 to 12 per cent., in carburetted water gas it reaches 30 per cent., and in blast furnace gas about 25 per cent.

The casualties are traceable to several common causes, of which the principal are, besides ordinary leakages from joints and taps or in pipes or flues conveying gas: (1) gradual escape into small engine rooms, weigh cabins or offices; (2) cleaning and repairing engines and tanks, scrumbles or blast furnace flues; (3) inefficient disconnection from the blast furnace of the flue during cleaning; (4) charging cupola furnaces; (5) percolation of gas through several yards of soil from underground flues; (6) conveyance by the wind of gas escaping from defective reservoirs through ventilators and open windows into workrooms at a distance; (7) ignorance of the danger and of the earliest symptoms; (8) inodorous nature of the gas; (9) working alone; and (10) lack of rescue appliances.

A workman employed by the Frodingham Iron & Steel Co., Ltd., was overcome by gas in a manhole at the Company's blast furnace at Scunthorpe. After several ineffectual attempts had been made to rescue the unfortunate man, Thackeray, a fellow workman, volunteered and, tying a handkerchief over his mouth, entered the manhole and succeeded in raising the man sufficiently to enable other workmen outside to get him out, but it was too late to restore him. Thackeray himself was overcome by the gas and did not recover entire consciousness until the following morning.

Tied a handkerchief round his mouth! Again ignorance of the danger of the symptoms and of the right means of rescue!

An insidious gas of which you do not require to be told the poisonous properties — sulphuretted hydrogen gas which, in a proportion of 1 in 1000 parts of air, causes unconsciousness — is a source of poisoning in the cleaning out of tar stills and of sewers in the absence of proper precautions.

Alfred Butterfield, a workman employed at the Luton Corporation descended a sump hole at the Luton Sewage Farm and was overcome by foul gas which had accumulated there. William Brandon immediately went to his rescue and descended the hole but was overcome by the gas. In spite of the serious danger disclosed by the previous attempt at rescue, Herbert Carter decided to make the descent and placing a handkerchief over his mouth, was lowered by two ropes into the hole. There he found that Butterfield was dead and Brandon was unconscious. He placed a rope round Brandon and they were both drawn to the surface. Carter then descended again and attached a rope to Butterfield.

A handkerchief again! You will almost think it is the only remedy we can suggest in England. Such is, however, not quite the case. The measures we recommend in cleaning out tar stills are: (1) complete isolation from adjoining tar stills; (2) ventilation of every tar still before persons are

allowed to enter; (3) inspection by the foreman of the tar still before any workman is allowed in it; (4) foreman and all persons employed in tar stills should wear a rope securely fastened, with a long end left free, and two men outside whose sole duty should be to watch and draw out any person appearing to be affected; (5) provision of an oxygen cylinder with a mouth piece and printed instructions as to the use of the bottle and the method of employing artificial respiration.

The cases I have cited are all instances of the award of the Edward Medal which, on the recommendation of the Home Secretary alone, the King, as representing the country, has made since 1909 to his subjects who, in the course of industrial employment, risk their lives in the effort at rescue not only in Great Britain, but in all British Dominions or territories under his protection. The medal bears on the reverse the King's effigy, and on the obverse a design and the words "For Courage."

I thought before I came to the States that you had nothing quite comparable with the Edward Medal. Neither have you, but I had forgotten the Carnegie Hero Fund, the records of the awards under which tell just the same story, with even worse insistence — ludicrous indeed were it not so tragic — of the fatal pocket handkerchief. Thus:

Edward Davis, 32, died saving James Dougherty on March 27, 1916. With a wet handkerchief over his nose and mouth he entered the kettle full of deadly fumes, but he was affected by the fumes before he could lift Dougherty, and hurriedly ascended. After another man had made an unsuccessful attempt, Davis re-entered with the handkerchief over his face and a rope tied round him. He tied another rope to Dougherty and hurried from the kettle. As he emerged he gasped and fell unconscious, and efforts to save him with the pulmotor were fruitless.

Perhaps of all the gases and fumes the most treacherous are nitrous fumes. They are commonly given off in nitrating processes in explosive and synthetic dye factories. They seem at any rate to be the fumes with which familiarity breeds contempt more readily than with others, and with them perhaps the folded handkerchief is the rescue appliance relied on more often than any other. The full effect of inhaling these fumes is not felt immediately, and so workers often continue at work and unwittingly inhale a fatal dose. What happens then is that after the initial gassing effects pass off, the workman feels better and continues his work for perhaps the rest of the day. The increased exertion of going home makes him feel short of breath, and this shortening of the breath gets steadily worse until he swims for his life. The explanation of the delayed action is simple, seeing that it takes a few hours for the inflammatory process set up in his lungs to develop, and finally to drown him in his own secretions.

A man named Richard Morgan was repairing an electric wire on the top of a four-story building, when he was overcome by poisonous fumes given off by an overflow of acid on the ground floor. The fumes, which were dense and suffocating, soon filled the building, and McNab, a foreman fitter, and two other workmen went up an outside staircase provided for cases of emergency in search of Morgan, but receiving no reply to their shouts, descended. McNab then, hearing from other workmen that Morgan was on the roof, went up the staircase again, but without success. McNab then went up for the third time, and succeeded in entering the room where Morgan was. Crawling on his hands and knees, he managed to grasp Morgan's hand, and drag him out to the landing, where he obtained assistance in carrying Morgan downstairs. McNab showed presence of mind and persistent bravery in face of danger, though his effort to save Morgan's life was unfortunately unavailing, as Morgan succumbed after some hours to the effects of the poisonous fumes.

In addition to the resourcefulness and bravery shown in rescue work, perusal of the gassing cases bring out another equally significant feature too little dwelt upon — namely, the extraordinary sense of responsibility shown often by the workman and

the marvellous pertinacity and devotion to duty he displays, often in the face of dire peril to his own life. Instances I have cited show this and show how this sense of responsibility forces him even to break through the strictest orders. A man, Charles Smith of Rawtenstall, last year was in charge of some revolving benzine degreasing vats. Blow-off cocks were fitted, and one of them gave way, allowing the benzine to escape, of which there were 3000 gallons under a pressure of 30 pounds. Smith entered the vat room four times in unavailing attempts to turn off the steam. He was three times fetched out, overcome by the benzine fumes. After the third time he was left alone under a promise not to return, by the night foreman who was called away to search for two other men. On coming back he could not find Smith where he had left him and guessing what had happened he returned to the vat room to find him lying unconscious — unconsciousness from which he never recovered. Cases like this where death claims its victims come to light, but they are but instances of what happens more often than one can count. The paramount instinct of setting the wrong right — perhaps of correcting a mistake and being rid of the reproach of conscience — is there.

How can the way in which gases and fumes act be best presented to the mind's eye so that they do not confuse, but fall into their place in ordered sequence; so that, knowing the type, we can predict the probable action of a similar, related compound. Such a classification is not easy because classification should take account of the relative toxicity of the compounds — the fact that one is very poisonous, and another only slightly so, like the compounds of arsenic. Account must also be taken of the various processes and the way in which they may be used as, for example, the ease or otherwise with which exhaust ventilation can be applied; and if the list is not to lead to false ideas, it must be complete, or else omission may lead to the assumption that those omitted are harmless. This, for instance, has occurred in the case of benzol. In 1915 the French government wrote, asking for our experience of danger attaching to the use of benzene. They did not say for what purpose they intended to use it, but it turned out it was as a solvent for india-rubber in the proofing of balloon fabric. At that time, we had only had experience of unconsciousness produced by accidental breakage of a benzol still, not of chronic poisoning. But at the back of my mind I knew of one or two isolated instances of profound disturbance of the blood resulting in symptoms resembling scurvy, which had been reported in the United States and Sweden. I said to myself, "Is not this a negligible danger to which I had better not refer?" Well, those very symptoms of chronic benzol poisoning, a form of pernicious anemia, occurred later, and disturbed profoundly the peace of mind of the great rubber manufacturers in the country.

As a result of dilution with air, most industrial poisons can be absorbed only in very minute doses, yet some are so much more potent than others that one, like naphtha, may be disregarded, and another, like arseniuretted hydrogen gas or sulphuretted hydrogen gas or carbonic oxide, prove fatal. For some of them, therefore, the term industrial poison is a misnomer until the amount absorbed has reached a certain concentration. But we must have a classification, and the best line to adopt is a chemical basis, because whatever differences there may be between different members of the same chemical group, will be differences of degree and less marked than those produced by another chemical group. Thus, you would have the two main divisions of (1) Inorganic, and (2) Organic poisons.* The sub-divisions of (1) inorganic

* This list is practically that of Fischer, formerly Director of the Institute for Factory Hygiene, Frankfurt a. M.

poisons are: (a) *non-metallic* — chlorine, calcium chloride, hydrochloric acid, potassium chlorate, hydrofluoric acid, carbonic oxide, phosgene, carbon dioxide, cyanogen compounds, ammonia, nitrous fumes, phosphorus, phosphoretted hydrogen, arsenic compounds, antimony compounds, sulphur dioxide, sulphuric acid, sulphuretted hydrogen, carbon bisulphide, chloride of sulphur; and (b) *metallic* — chromic acid and chromates, manganese dioxide, sulphate of nickel, mercury and lead. The sub-divisions of (2) the organic substances are: (a) the *unsaturated carbon compounds* — benzene, petroleum, methyl, ethyl, amyl, and allyl-alcohol, oxalic acid, formal- and acetaldehyde, acrolein, acetone, methylbromide and iodine, nitroglycerine, dimethyl-sulphate and amyl acetate; and (b) the *aromatic series* — benzol, the nitro and amido derivatives of benzene, toluene and their homologues (which would include dinitrobenzene, trinitrotoluene, anilin, paranitranilin, etc.) and their chlorine substitution compounds. Then would come phenol and its nitro derivatives (dinitrophenol and picric acid), the chlorine compounds of carbon, ethylene and ethane (such as carbon tetrachloride and tetrachlorethane), and pyridin, naphthalin, benzidin, acridin and turpentine.

But we can summarize the effect on the tissues of various poisons briefly by classifying them as having action by:

1. Irritating the mucous membrane — chlorine, nitrous fumes, sulphur dioxide, formaldehyde.

2. Altering the constituents of the blood, which is peculiarly the property of the nitro and amido derivatives of benzene, of arseniuretted hydrogen gas, and of carbonic oxide gas.

3. Affecting the brain and nervous system — carbon bisulphide and the unsaturated carbon compounds.

4. Affecting metabolism by remote action on organs and tissues — phosphorus, lead, tetrachlorethane, benzol, toluene, and their nitro derivatives.

You see how complicated the matter becomes in attempting even so simple a classification as this, since overlapping comes in very quickly. When all is said and done, the number of the common industrial poisons is small, and you have done your duty if you have mastered these — carbonic oxide, sulphuretted hydrogen, lead, mercury, nitrous fumes, and arseniuretted hydrogen gas.

[Lantern slides of the Edward and Albert Medals, rescue appliances, and method of exhaust ventilation were shown.]

EXPERIMENTAL TRINITROTOLUENE POISONING *

SAMUEL R. HAYTHORN, M.D.
(From the William H. Singer Memorial Research Laboratory, Pittsburgh)

IN October, 1917, an employee of a large trinitrotoluene (trinitrotoluol, T.N.T.) factory was admitted to the Allegheny General Hospital with an acute toxic jaundice. He lived less than twenty-four hours and the principal lesion found at autopsy was that of a very pronounced yellow atrophy of the liver. Reference to the literature showed that several such instances had been noted in England (1) (2) (3), and that one similar case had been reported (4) in the United States. In spite of the fact that the reports on animal work were very meagre (5) (6) (7) and were chiefly of the negative sort, we began at once to try to produce trinitrotoluene poisoning experimentally. We hoped not only to be able to study the histogenesis of the liver lesions in this way but also definitely to determine the most important route of entrance of the toxic substances to the body. Reports of our findings in the case of toxic jaundice and of our earlier experimental work were made in former papers (8) (9). The purpose of this paper is to report all of our experimental work, and to apply the results as far as it is possible in interpreting the clinical manifestations of T.N.T. poisoning.

Experiments to Determine the Most Important Route of Absorption of Trinitrotoluol by the Body

Trinitrotoluene workers are exposed to T.N.T. in several different ways, depending largely on the department of the factory in which they are employed. If the individual works in the nitrating room, he inhales gases from volatilized T.N.T. and from boiling acids. If he is in a grinding department or some other dusty part of the works, he gets a certain amount of it into his nose and mouth, on his hands, and into the meshes of his clothing, and probably inspires a small amount of it. If he is a packer of wet T.N.T., he is exposed to the dust adhering to the walls of the containers which are returned to be refilled, and, at times, also has his hands in contact with the wet, soggy, irritating masses of T.N.T. It appeared then, from the way in which the worker is brought in contact with T.N.T., that there were at least three possible routes of entrance for the poison; namely, through the air passages, through the skin, and by way of the alimentary tract.

Absorption along the Air Passages

Theoretically, there are two possible ways of producing poisoning by way of the air passages — one, by subjecting the animals to the fumes of volatilized T.N.T., and the other, by forcing the dust into their lungs.

Our first set of experiments was with the fumes and consisted in placing four guinea pigs in a closed compartment where they were exposed daily to the gases formed by the evaporation of T.N.T. The exposures at first made were of one-half hour's duration, but as this caused the animals to exhibit no symptoms, the time was increased until they were given about three hours exposure daily. At first, the fumes were generated by placing a container full of T.N.T. on an electrically heated water bath, in which the water was kept boiling. The animals were far more seriously affected by the steam than by the fumes, so that later an electric hot plate was substituted for the water bath and the T.N.T. powder sprayed upon the plate from a small atomizer.

* Received for publication July 12, 1920.

With this method, volatilization of the powder occurred instantly, so that the box was soon filled with yellow fumes. After about a month, the four animals were accidentally overcome by the heat in the box and died from the effects. These animals exhibited no lesions which could be ascribed to T.N.T., and as no uncontaminated samples of urine were obtained during life, and as their bladders were empty at autopsy, it is not possible to state whether or not they absorbed any T.N.T.

The second set of experiments was conducted on two guinea pigs and two rabbits. These animals had gags placed in their mouths so that the interference to inhalation due to the intricate turbinate bones was removed. The fumes were generated by the atomizer and hot plate method, but were led into the box through a short flue to prevent over-heating of the animals. Catheterized specimens of urine from the rabbits were examined daily. On the fifth day a positive Webster's test was given by the urine from one rabbit. All of the other findings in this group were negative.

Smith (10) made the observation, in discussing the above experiments, that when T.N.T. vaporizes it is broken up into several different gases so that the animals did not receive T.N.T. as such. The single positive finding can be explained by the absorption of the T.N.T. dust which sublimated on the skin of the rabbit.

We found no evidence that fumes produce T.N.T. poisoning, though they undoubtedly play a part in the condition discussed under the heading, *Acute Gassing*.

In a recent report on the investigation of T.N.T. poisoning by the United States Public Health Service (11), mention is made of the successful introduction of T.N.T. dust into the lower air passages. Moore (5) and Putnam and Herman (12) have shown that the quantity of T.N.T. dust which is present in the T.N.T. factory is so small that it is hardly likely to be the cause of the poisoning. We performed a few experiments in which we attempted to insufflate the lungs with T.N.T. dust by blowing the fine powder from an atomizer into the back of the pharynx, the current being continued long enough to force the animal to inspire deeply. Again, our method of feeding, which we will describe later, undoubtedly led to a deposit of some of the powder in the larynx and trachea. Large phagocytic endothelial leucocytes filled with bright yellow granules were found in the lungs of many of the animals. These granules did not give the iron reaction, and we attempted to apply a modified Webster's test to frozen sections while watching for the reaction under the microscope. Our tests failed to prove that these granules were T.N.T., but it is possible that they were.

We believe from the above cited evidence that it is possible to force T.N.T. powder into the lungs under experimental conditions, but that the route as a source of poisoning to the T.N.T. worker is an unimportant one.

Absorption through the Skin

Most clinical observers believe the skin to be the most common means of absorption of trinitrotoluene and it undoubtedly plays a considerable part in bringing about poisoning. However, some of the evidence which has been advanced to prove that the skin is the only important means of absorption is not entirely convincing. Moore's experiment upon himself has not been borne out by others, and I have rubbed large quantities of T.N.T powder on my arms for several days consecutively, have obtained a reddening of the skin from the procedure, but have been unable to produce a positive Webster's test. Putnam's and Herman's argument that the dirtiest men were always the sickest scarcely rules out the possibility of these individuals

having carried a larger amount of T.N.T. powder to their mouths by way of the hands, food, etc., than the other individuals did, and the argument that the protective varnish cut down the occurrence of the poisoning does not take into consideration the fact that this varnish was regularly removed by thorough washing and cleansing with alcohol before the men went to their meals and homes.

Experimentally we produced liver lesions of the red, hyalin type in guinea pigs by inunctions with 10 per cent. T.N.T. ointment, in which lanolin was used as a menstruum. The symptoms in these animals did not appear until after repeated inunctions, and positive Webster's tests were obtained on catheterized samples of urine from rabbits which had been rubbed between the shoulders with the ointment no earlier than five days after the first rubbing. Subcutaneous injections of T.N.T. mixed with lanolin (10 per cent.) produced positive Webster's tests in the urine. One young guinea pig died within twenty-four hours after a 2-c.c. subcutaneous injection of the material. This animal developed a general edema in which the fluids of the body were stained bright yellow. Five other animals injected on the same day showed no ill effects.

Absorption along the Alimentary Canal

From the standpoint of practical work it is scarcely possible to exclude the intestinal route. The workers complain of the bitter taste in the mouth and the substance is exceedingly soluble in saliva and in gastric juice. The use of "chewing tobacco" is a common habit among the employees, and before extreme cleanliness was insisted upon, the men were as a rule careless about washing well before eating their meals. The dust which collects in the posterior naso-pharynx is commonly swallowed. Altogether there are many ways in which T.N.T. may reach the intestinal tract.

Experimentally, feeding is the surest way of producing poisoning in animals, though individual susceptibility makes it very difficult to determine the lethal dose. Young guinea pigs are much more susceptible than older ones, but the latter occasionally show surprising variations. T.N.T. is quite soluble in milk and poisoning can be produced by feeding milk saturated with the powder. Graham crackers soaked in T.N.T. and milk produce very violent diarrheas in the animals, but the bitter taste makes it difficult to get the animals to eat them. We were most successful in depositing the powder in the back of an animal's throat and following this either with a drink of milk, water, or 10 per cent. alcohol, and holding the nose until the animal swallowed. Guinea pigs fed in this way presented poisoning symptoms in from three days to two weeks, depending on the dose, age of the pig, and individual susceptibility. Rabbits fed in a similar way showed blood changes and positive Webster's tests in catheterized samples of urine, after two or three feedings.

We conclude, therefore, from our experimental results that both the skin and alimentary tract are important routes of entrance of trinitrotoluene to the body, and that the lungs and air passages absorb apparently negligible quantities.

Solubility of T.N.T. in Body Fluids

We found that all of the body fluids which we tested would take up enough T.N.T. to give positive Webster's tests, but we gave up the endeavor to determine quantitative solubilities because of the difficulties of quantitative determinations, since it required widely varying quantities of different samples of the same fluid to absorb a given quantity of the powder, and because the value of the results did not ap-

pear to justify the work necessary. Several samples of each of the body fluids mentioned in the following table were incubated with T.N.T. powder for twenty-four hours, were filtered, the reaction taken, the general appearance noted, and the filtrate divided into two portions. One portion was examined by superimposing a layer of 40 per cent. potassium hydroxide in absolute alcohol; the other portion was acidified by sulphuric acid, extracted with ether, and tested with the hydroxide and alcohol solution according to Webster's method. The number of plus signs indicates roughly the relative rapidity and strength of the reaction and the permanency of the brown color which remained as the end reaction.

Body Fluid	Appearance	Direct Test	Webster's Test
Saliva	orange-brown	+	+ +
Stomach juice	colorless	+ + +	+ + +
Milk (cow's)	yellow to orange	+ + +	+ + + + +
Human bile	brown to black	+ + +	+
Human serum	dark brown	+ + + + +	+ +
Urine	yellow-brown	+ + +	+ + + +

Clinical Types of the Disease with Reference to Experimental Data

Trinitrotoluene in man has manifested itself in several different clinical forms, but it is not possible to differentiate all of them experimentally. The types generally described are "Acute Gassings," "Dermatitis," "Minor Poisonings," "Severe Toxemias," "Toxic Jaundice and Acute Yellow Atrophy of the Liver," "Toxic Anemia" and "Aplastic Anemia."

Acute Gassings. — This form of poisoning is due to the inhalation of poisonous gases formed during the manufacture of T.N.T., though not due to T.N.T. as a chemical entity. Dr. F. W. Matthewson (13), physician for a large T.N.T. factory, treated about seventy-five employees, who had been "gassed" while at their work. Most of the instances occurred in the nitrating room where toluol, sulphuric acid and nitric acid were mixed together and boiled in large vats called nitrators. The nitrators used in this plant were large vats 12 feet high and 10 feet in diameter, and were closed except for a small opening near the top through which the operator watched to see that the acids were boiling properly. The boiling was continued for two or three hours at a time and during this time the operator was more or less constantly exposed to acid gases. The bulk of the gases were carried away from the nitrators in iron pipes, which led into terra cotta pipes laid on lead sheeting to prevent acids from dripping through. According to Smith (10) there are always relatively large quantities of nitric acid, nitrous oxide, methane, hydrogen, and chlorine gases present in the nitrating rooms. Most of the instances of acute gassing followed sudden exposure to large quantities of gas, resulting from the erosion of pipes, minor explosions, or difficulty in controling the nitrator, but sometimes the clinical picture of acute gassing resulted from prolonged exposure to small quantities of the fumes.

The suddenly gassed individuals became choked, cyanotic and sometimes lost consciousness. They were resuscitated without much difficulty and given forced inhalations of aromatic spirits of ammonia which was kept on hand in iron cylinders. The men were generally removed to their homes in a few hours. The more severely gassed began to spit blood at once and some continued to do so for several days. Occasionally, the gassings were followed, within twenty-four hours, by a chill, and numerous instances of severe bronchitis and moderate edema of the lungs followed. Complete recovery after several days rest in bed was the rule. Some, however, developed bronchopneumonia, and there were two instances of lobar pneumonia.

A number of sputa from the bronchitis cases were sent us, and bacterial examination revealed the usual respiratory flora, with a predominence of pneumococci, streptococci and staphylococci. The bronchitis and bronchopneumonia apparently resulted from the implantation of these organisms on the injured surfaces of the bronchi and bronchioles. Wagner (14) reported an autopsy on a case of bronchiolitis obliterans in a T.N.T. worker. The lesions in his case probably resulted from an acute gassing which destroyed the superficial layers so that attempted healing took place by organization. Dr. J. P. McKelvy called my attention to a case of bronchial affection following prolonged exposure to gases in the nitrating room, which was of unusual interest from the radiographic findings.

The patient, when admitted to Dr. McKelvy's service at the Allegheny General Hospital, gave the following history. He had been employed in the nitrating room of a T.N.T. plant for a number of weeks, where he worked twelve hours a day in the fumes. For a month before his entrance to the hospital he had suffered from shortness of breath, pains in the chest and cold in the head. He had no venereal or genito-urinary infection but complained bitterly of the pain and burning on urination which he said was worse when he was on duty. He had given up his work for a few days but was offered a little better position and returned to the plant. His symptoms became so much worse that he entered the hospital. At the time of entrance to the hospital he was suffering from pain all over the chest and a severe cough. Physical examination showed the presence of moist râles throughout both lungs, most marked over the bases, and a prolongation of the expiratory note. He had little or no sputum. His temperature varied from 99° to 100° for the first three weeks and then became normal. The urine showed a slight trace of albumin, a positive Webster's test, a strong test for urobilinogen, no evidence of bile and microscopically a few hyalin and granular casts. The red blood count was 5,230,000; the white count was 10,000; the hemoglobin, 105 per cent.; and the differential count showed polymorphonuclear leucocytes 68 per cent., lymphocytes 18 per cent., and large mononuclear leucocytes 10 per cent. The first X-ray report suggested a cavity in the left apex with marked infiltration of the bronchi. The second X-ray plate made one week later showed marked thickening in the region of the hilus, with infiltration of the bronchi and mottling throughout both lungs. In another week there was no evidence of consolidation or suggestion of cavitation, but the prominence of the bronchial tree and mottling was still present. Two weeks later the chest was entirely negative. Recovery was apparently complete.

The striking things about the case were the slow onset of the irritative bronchitis without other clinical evidences of infection and the great prominence of the bronchial tree on the radiogram, with the gradual fading of these shadows as the patient's condition improved. In the light of the findings in Wagner's case it was suggested that healing took place by partial organization and retraction of the exudate in the bronchi.

Briefly stated, the lesions in acute gassings appear to consist in the injury to the surface epithelium, the exudation of serum, the invasion of organisms from the mouth and upper air passages, and the development of a more or less persistent bronchitis and bronchiolitis, with an occasional instance in which the bronchial walls are so severely damaged that hemorrhage and fibrinous exudation take place, the basement membrane is destroyed, and healing occurs by the organization of the exudate. The condition, while not due to T.N.T., must be considered with T.N.T. poisoning because it is a form of gas poisoning incidental to the manufacture of T.N.T. Steps to prevent it must come up for consideration when the means for controlling the dangers to the manufacturers of trinitrotoluene are thoroughly worked out.

T.N.T. Dermatitis. — T.N.T. is a local skin irritant and tends to produce staining, redness, hardening and scaliness of the skin. Instances of dermatitis have been described by White (15), Putnam and Herman (12) and others (16), (17). I personally saw several instances which were complicated by the ordinary chaffing due

to exposure of the hands in winter weather. One of these instances showed deep cracking and crevicing.

We attempted to produce T.N.T. poisoning in guinea pigs and rabbits by rubbing them with dry T.N.T., with wet T.N.T., and with T.N.T. suspended in oil. Dermatitis was developed more or less readily by each method. We purposely selected the back between the shoulders for the point of inunction because it was difficult for the animals to irritate the area by scratching. The skin became thickened, dry, scaly, the hair dropped out, and finally thick folds, or rugae, were formed. We also anointed several rabbits' ears because the loose tissues of the back were not very favorable for obtaining good sections. The ears passed through similar stages. When the skin was removed the subcutaneous tissues were always found to be stained yellow. Microscopically, the animal lesions resembled mild burns. The stratum corneum was thinned out and broken in places; the crusts were superficial and did not reach through the epidermis. The Malpighian layer was edematous, the fixed cells were swollen and the layer was infiltrated with a few polymorphonuclear leucocytes. Between the Malpighian layer and the papillae there were spaces filled with serum and polymorphonuclear leucocytes; the papillae and deep connective tissue fibers of the corium were edematous, the collagen fibrils were swollen, and the spaces between them were infiltrated with leucocytes, many of which were flattened out and appeared spindle shaped from pressure. A few plasma cells were present. The ducts of the sweat glands and hair follicles were profusely infiltrated with acute inflammatory cells.

Minor Poisonings and Severe Toxemias. — Many of the animals undoubtedly passed through phases known in the human as "minor poisoning" and "severe toxemia," but we were unable to differentiate these stages. Diarrhea was a very common early symptom in the animals fed T.N.T. and was particularly noticeable in those fed oatmeal crackers soaked in milk saturated with T.N.T. Later on, constipation was the rule.

Toxic Jaundice and Acute Yellow Atrophy of the Liver. — The most serious effect of absorbing T.N.T. is the toxic jaundice and acute yellow atrophy of the liver which has been found associated with it. Twenty-nine autopsies on cases of this kind have been reported; by Spilsbury (18) seven cases; Thursfield (2) one case; Livingstone-Learmonth (16) one case; Martland (4) one case; Stewart (19) eight cases; O'Donovan (3) two cases; Oertel (20) one case; Turnbull (21) three of his own and four submitted cases; and our own case (8). All of the clinical histories are more or less similar, and the characteristic findings may be summarized as follows. The employees recovered from the initial nervousness and early toxic symptoms common in beginners and continued to work for several months in comparative comfort before the severe toxic symptoms, accompanied by jaundice, appeared. A few of them had quit the T.N.T. factory and sought other work. As the jaundice developed, the affected individual experienced headache, general uneasiness and an itchiness of the skin. Medical examination revealed an elevated temperature, and a thorough urine examination gave positive tests for bile or bilirubin, a strongly positive Webster's test, and generally a positive test for albumin. Later the toxemia increased and vomiting, subcutaneous hemorrhages and pain over the liver developed. Hemorrhages from the lungs and stomach were less constant signs and, finally, localized edemas appeared, the liver dullness decreased greatly in size, and death ensued.

The striking thing at autopsy in these cases was the very small, flabby liver which showed masses of red necrosis with remain-

ing portions of yellow liver tissue greatly infiltrated with fat. The left lobes were constantly more extensively affected than the right, and the weights varied from about 400 to 1200 gm. The gross picture of all of the cases was characteristic of the classical acute yellow atrophy. Other important findings in nearly all of these cases were general icteric staining of the skin and of all the viscera, acute toxic nephritis, acute congestion of the spleen with enlargement, and petechial hemorrhages of pericardium, pleura and stomach mucosa. A few instances of hemorrhagic infarction of the lungs were reported. The bone marrow was found hyperplastic three times out of six examinations.

Histologically, the liver lesions are probably identical with those of so-called acute yellow atrophy. Several observers made early attempts to show that there was a difference in the amounts of fat and in the microchemical reactions of the fat present in the two conditions, but is it probable that the only differences were individual variations, which were dependent upon the stage of degeneration of the liver at the time of death and not upon any actual differences in the types of degeneration found.

Attempts to Reproduce the Liver Changes in Animals

Trinitrotoluene was administered to fifty-one animals, not counting controls, in the endeavor to produce acute yellow atrophy. Guinea pigs and rabbits were generally used, but one small series of dogs was tried. Nineteen out of twenty-eight guinea pigs exhibited liver lesions at autopsy but only one instance could be justly called acute yellow atrophy. We found rabbits and dogs less susceptible but we did not use Voegtlin's method in feeding the latter animals. The guinea pigs received relatively larger doses than the other animals.

T.N.T. was given to the animals by feeding in various ways, was injected subcutaneously in oil, was anointed in lanolin, and was dissolved in serum or normal salt and injected intravenously. Of all of these methods we had the best results in placing a small amount of powder on the back of the tongue by means of a glass tube and by following it with a drink of water or milk, and then holding the animal's nose until the material was swallowed. In one series, 10 per cent alcohol was used instead of water, because of the popular belief that the drinking of alcohol aggravates T.N.T. poisoning, but we obtained no evidence to the effect that poisoning progressed more rapidly or was more severe when alcohol was used. At first each dose was weighed carefully but this was given up as useless because the animals usually succeeded in spitting out a part of the powder and it was not possible to tell how much was actually swallowed.

In both guinea pigs and rabbits symptoms began to appear in from three to seven days. Guinea pigs showed earlier and more constant blood changes, while rabbits were found of value chiefly because of the ease with which they were catheterized and the urinary changes followed. Some animals died soon after symptoms appeared and some were kept in various stages of partial poisoning for weeks or months.

Symptoms of Experimental Poisoning.— The symptoms of experimental poisoning were fairly constant for both guinea pigs and rabbits, but were more exaggerated in the former. A description of the typical changes noted in guinea pigs covers the ground for both animals.

After the guinea pigs had been fed with T.N.T. for two or three days, brownish liquid stools or unformed fecal masses were found in the cages but after a few more days only scanty hard scybala were seen. Blood counts made in from four to eight

days showed a moderate anemia. T.N.T. was sometimes stopped at this stage and the animals always recovered. After resting for several days, the feedings were resumed, and so on. In one series of animals, T.N.T. was given daily for some time and these animals exhibited mild symptoms for several days and then suddenly became emaciated, lost from 100 to 200 gm., and showed evidences of marked blood destruction. When the animals in the latter series began to stay in one position and refused to eat, T.N.T. was discontinued for a time. Some of them recovered and others grew steadily worse and died in a day or two. Just before death they would sit shivering in one position and wobble from side to side as if drunk. The mucous membranes became purplish-yellow, the eye grounds blanched and the soles of the feet became deeply cyanotic. The heart action became slow and sluggish, and it was almost impossible to get blood enough from the ear to make a satisfactory count. The temperature was subnormal, 94° F. or less by rectum. Loss of bladder control and dragging of the hind legs were sometimes seen. One pig developed well-marked clonic convulsions for two hours before death.

Gross Autopsy Findings. — At autopsy, the following findings were commonly seen in guinea pigs. Anointed animals constantly showed a yellowish discoloration of the subcutaneous tissues beneath the area of inunction. The brain and central nervous system showed no gross changes. The heart was dilated, and the serum from the heart was yellowish-green in color. The lungs were yellowish and partially collapsed. The stomach was distended and so soft that the wall tore at the slightest manipulation. The intestines were generally empty. The liver was enlarged, pale yellow and fatty and contained sharply defined white foci with red borders. The gall bladder was, as a rule, well filled and the contents were often thin and opalescent. The spleen was enlarged, congested and black in color. The adrenals were orange-yellow. The kidneys were deeply bile stained. The skeletal muscles were generally yellow and bile stained. The bone marrow was deep purple in color and solid in consistency.

A condition similar to acute yellow atrophy of the liver was found in one guinea pig. This animal had been fed T.N.T., off and on, for nearly five months and, at one time, had recovered from a stage of poisoning which had proved fatal to all other animals. The liver, in general, was a bright yellowish butter color, divided up by intersecting red lines. Two of the lobes were shrunken and contained large reddish lesions with a puckering of the other liver tissue which radiated toward these reddened foci. The other organs resembled those found in all severe T.N.T. poisonings.

Rabbits presented similar but less marked symptoms and those which died from the effects of T.N.T. presented liver, spleen and kidney changes similar, both macroscopically and microscopically, to those found in the guinea pigs. Hyperplasia of the bone marrow in them was found many times.

Microscopic Changes in Experimental Lesions

Sections of the *brain*, *heart*, and *skeletal muscles* showed no convincing changes.

Lungs. — The lungs were in part collapsed and often edematous. One or two instances of early pneumonia were seen and some of the lobules were hemorrhagic. In the animals in which T.N.T. was forced into the lungs, large phagocytic endothelial cells were found in the alveoli and these contained both black granules due to anthracosis and coarse yellowish granules which did not give the iron reaction.

Liver. — The liver lesions were of several kinds, varying largely with the duration of

the poisoning, and may be separated, for purposes of description, into focal necroses, fatty changes and diffuse areas of necrosis.

The earliest lesions seen were small sharply defined foci of necrosis. These varied in size from the involvement of a few cells only, to about one-third of a lobule and were located near the central vein. Some of these small foci appeared to contain a few fibrin strands and were infiltrated with polynuclear and endothelial leucocytes. Some were simply sharply demarcated islands of cells which took eosin but no nuclear stains and were not infiltrated with inflammatory cells. A third type of focal necrosis consisted of a small area of cells which appeared to have undergone coagulation necrosis and chromatolysis. The cells of these areas stained irregularly and the nuclear material presented the appearance of flowing from one cell to the next. These lesions resembled the necrosis of eclampsia save that none of them was found near the periportal connective tissue.

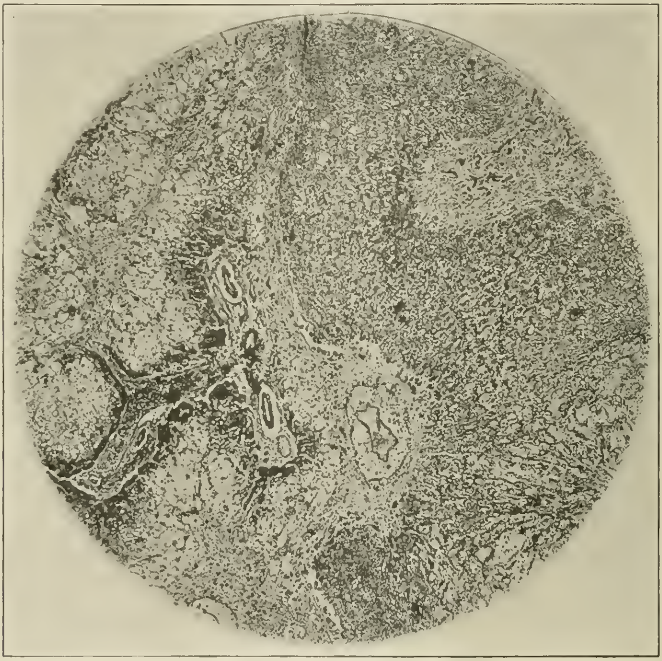

Fig. 1. — Liver of guinea pig which had been poisoned repeatedly with T.N.T. for a period of nearly five months. Magnification is Zeiss AA Objective, No. 2 eyepiece. The left half of the figure shows a portion of the liver which has undergone extensive fatty infiltration, the interlobular connective tissue apparently being increased. The right half of the figure shows a portion of the liver in which the lobules are wholly necrotic, the stroma and cell spaces filled with blood alone remaining. Projecting into this area from the upper right-hand corner is an island of periportal connective tissue showing the proliferation of bile ducts. The gross appearance of the lobe from which this tissue came was that of acute yellow atrophy.

In the animals where the poisoning was carried out over a more prolonged period, the liver lobules showed advanced fatty

changes of both globular and granular types. The globules were found in the cells about the central vein and in some instances were seen to some extent throughout all of the lobule. In the very advanced fatty changes the inner one-half to one-third of the lobule was infiltrated with large fat globules and the cells were so greatly swollen that sinusoids appeared to have been compressed so tightly as to exclude the red blood cells from this portion of the sinus. Occasional large phagocytic endothelial cells filled with brown pigment remained to mark the positions of the sinusoids in such areas. Outside of this globular fatty area there were cells showing granular change, which Sudan III stains showed to be finely granular fat. The cells immediately about the periportal areas appeared to be infiltrated the least and the blood sinuses in these areas were usually congested. Associated with the fatty changes were fairly large areas of necrosis. These areas were found adjoining the central vein, in the mid-zonal regions and were common just beneath the liver capsule. The cells in these areas stood out bright red with eosin-methylene blue stains. In some places the cells seemed to have disappeared entirely, while the stroma which remained stained much redder than did the stroma of the more normal portions.

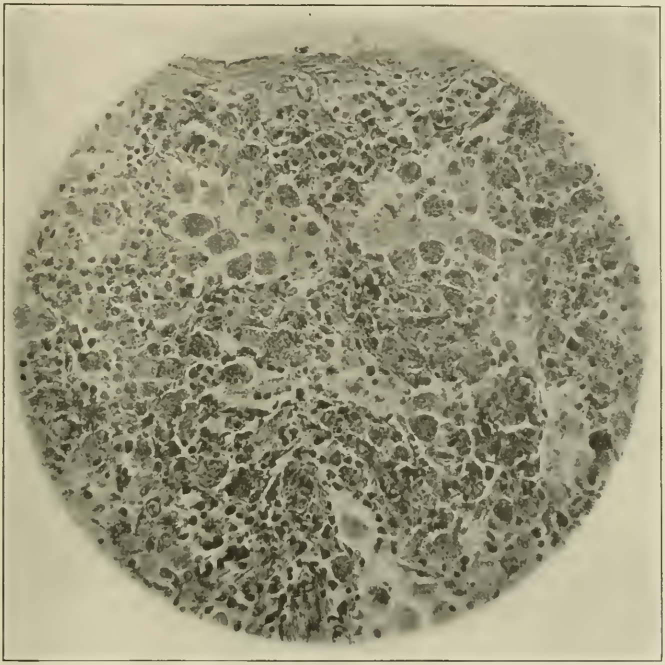

Fig. 2. — Section of the spleen of a guinea pig poisoned with T.N.T. Magnification, Zeiss DD Objective, No. 4 eyepiece. Note the large endothelial leucocytes, phagocytic for red cells, cellular debris, and blood pigment.

The third type of lesion was similar to focal necrosis, save that it was diffuse and

involved a number of lobules or at least the greater part of a lobule. Here the cells retained their normal arrangement and outlines but took only the diffuse stain. The borders of these areas were more or less infiltrated with inflammatory cells and were surrounded by areas of liver cells filled with fat globules.

In the liver which was grossly "yellow atrophy," all of the remaining liver cells found in the areas which had appeared yellow in the gross, were distended with fat globules. The red areas were made up of groups of necrotic lobules in which only the outlines of the stroma, the periportal connective tissue bundles, and the structures contained within them, were recognizable. In one animal, which had recovered from a very severe poisoning, the periportal bundles appeared to have approached much nearer to each other than normally. They contained a definitely increased amount of connective tissue together with numerous bile ducts. This finding suggested that repeated repair of the T.N.T. liver necroses would lead to cirrhosis.

Spleen. — The microscopic changes in the spleen of animals which were repeatedly poisoned and those which survived a considerable number of doses were constant and fairly characteristic. The blood sinuses became enlarged and quite definitely outlined. Most of the free red and white cells disappeared from the sinuses and their places were taken by large phagocytic endothelial leucocytes filled with golden pigment, blood fragments and whole red cells. These large cells arranged themselves in columns along the fine filamentous trabeculae and were also found free in the spaces. The appearance was suggestive in a way of Gaucher's spleen. The central portions of many sinuses surrounded by these large cells were clear open spaces. The only individual variations in the spleens which were free from postmortem changes were in the relative amounts of pigment and red corpuscles contained within the cells. In some phagocytes the pigment greatly predominated while in others the red cells were seen almost to the exclusion of the pigment. The pigment gave a strong positive iron reaction. While many of the spaces contained nothing but the large phagocytes, others contained a few red cells and an occasional normoblast. In a few instances normoblasts together with other red cells were seen incorporated within the large phagocytes. Nucleated red cells in the spleen were present in about the same proportion as in the vessels of other organs. The Malpighian follicles, vessels, and trabeculae appeared normal.

Adrenal Glands. — While most of the adrenals showed no microscopic changes there were several instances where small groups of medullary cells had entirely disappeared and the spaces formerly occupied by them were filled with free red cells.

Kidneys. — In all of the severely poisoned animals the histologic changes in the kidneys were similar. The glomeruli were congested and the glomerular spaces dilated and filled with cellular debris, free pigment granules and occasionally with the shadows of red blood cells. Some of the convoluted tubules were dilated and filled with red blood cells, red staining granular material and brown granules, and others had their lumina closed by the approximation of the swollen epithelial cells which, Sudan III stains show, contained granular fat. The straight tubules were dilated and filled with large casts which were made up chiefly of brown granular material, though they sometimes contained recognizable red blood cells. As a rule the interstitial tissues were not infiltrated with cells and the vessels appeared normal.

Bone Marrow. — The bone marrow was always taken from the hollow portion of the bony shaft of the femur. The amount

of fat present was constantly much less than that found in a series of specimens taken from supposedly normal animals, though there was a considerable variation in the amount seen in the normal series. Some specimens from T.N.T. animals showed no fat vacuoles while others showed a few which were widely separated. The megakaryocytes and multinucleated giant cells were numerous and often appeared arranged in groups of three or more. The latter type of cell was especially numerous, generally containing a great many large round vacuolated nuclei. These cells were not found to be phagocytic for either red or white cells. Many large groups of nucleated red forms were found and these cells appeared to occur in nests, though we were unable to determine that the normoblasts were peripherally located and the megaloblasts centrally situated, etc. These nests often contained all types of nucleated red forms. Some were large red cells with a greyish or purplish protoplasm and a large nucleus in which the deep blue chromatin strands were slightly separated. Some were equally large cells with clear red protoplasm and a deep blue compact nucleus. Some were typical normoblasts and some were normoblasts with two or three nuclei or with large lobulated nuclei, showing from three to five lobulations. An occasional microblast was found. Of the myelocyte series the coarsely granular eosinophilic myelocytes were the most common cells and they constantly occurred in nests or groups. A few polymorphonuclear eosinophilic cells were present among them. Other forms of myelocytes and leucocytes were abundant and a smaller number of lymphocytes were present. Occasionally large endothelial leucocytes filled with red blood corpuscles were seen, but they were not numerous in any specimen. One thing was definite about them and that was that they were able to phagocyte nucleated red forms as well as ordinary erythrocytes.

Chemical Tests

Numerous chemical examinations were made on the blood and urine of the animals during life and on the serum, bile, urine and tissues after death. Tissue extractions made in various ways were uniformly negative with Webster's test.

Chemical Examinations of the Blood. — The blood specimens for chemical examination were aspirated from the heart both before and after death. Just before death the blood became a deep red-brown or chocolate brown color and was rather thin. It was believed that the color was due in part to bile and in part to methemoglobin. Spectroscopic tests for methemoglobin in the blood were not convincing. The serum which was separated off from the blood was constantly stained a deep green bile color. While it was a constant finding that T.N.T. added to blood gave a positive Webster's test, we did not obtain an undoubted positive Webster's reaction on the blood or serum of a poisoned animal.

Bile. — Bile was aspirated with a clean syringe from the gall bladders of all of the animals which died of T.N.T. poisoning. The bile was sometimes thick and green and sometimes clear and almost opalescent. One undoubtedly positive Webster's test was obtained on bile and many doubtfully positive tests were reported.

Urine. — Urine specimens were obtained from the rabbits during life by catheterization, and from both guinea pigs and rabbits after death, by aspiration of the bladder with chemically clean syringes. These methods were used to exclude artificial contamination with T.N.T.

Appearance: The postmortem samples presented a fairly characteristic appearance. The urine was usually thick, opaque, and chocolate brown in color. Fresh specimens were acid. On standing, a heavy yellowish-brown flocculent precipitate sep-

arated out, leaving a distinctly bile stained reddish-brown fluid. Albumin was inconstant in catheterized specimens but was always positive in postmortem samples. Urobilin was often present in the antimortem samples and bile was positive in practically all of the postmortem samples. Webster's test usually became positive in two to three days in rabbits fed T.N.T., although there were instances in which the animal was definitely poisoned before the test was characteristic. Microscopically, the characteristic findings were great numbers of granular casts, some of which had red corpuscles adhering to them, and a large amount of brownish-yellow amorphous material, which cleared up on the addition of acetic acid.

Methemoglobinuria was suspected, because of the chocolate brown appearance of most of the specimens. We referred samples of urine from two guinea pigs and one rabbit to Dr. C. C. Guthrie of the University of Pittsburgh, for his opinion on this point. He reported that the urine of one of the pigs showed the presence of a distinct band in the red, occupying the position of methemoglobin, and of a diffuse band in the green, corresponding to reduced hemoglobin. The band in the red disappeared on the addition of ammonium sulphide. This sample had been centrifuged, but had not been otherwise treated. The second guinea pig urine which had been slightly acidified with acetic acid for purposes of clarification, gave the same spectroscopic reading, but the finding was a little less conclusive, because there was a possibility of some acid hematin having been formed by the addition of the acid. However, no excess of acid was used, the specimen was not heated, reduced hemoglobin was abundantly present, and the band in the red disappeared when ammonium sulphide was added. The rabbit's urine gave conspicuous oxyhemoglobin bands, a faint band in the red in the position of methemoglobin and no differentiation in the green to indicate reduced hemoglobin.

Dr. Guthrie concluded that the evidence was strong but not absolutely conclusive that methemoglobin was present in the urine of the two pigs, but that not more than a faint trace, if any, was present in the rabbit urine.

Excretion of T.N.T.

Based on the evidence furnished by Webster's test, the urine is undoubtedly the chief means of excretion of T.N.T. The statement of Voegtlin, Hooper and Johnson (11) that T.N.T. is excreted in the bile is borne out by our observations. We must, however, modify their statement that the feces never give a positive test. We obtained undoubted positive Webster's tests on the feces of all animals fed T.N.T. but did not get positive reactions in animals where T.N.T. was administered in other ways. This probably indicated that the bile is not an important vehicle of excretion from the quantitative standpoint.

Anemia

Anemia in T.N.T. workers is relatively common. Examples of mild toxic anemia, severe toxic anemia and aplastic anemia have been reported. Polycythemia (5 to 6 million cells) has been noted by Panton (22) and has been recorded by others in the very acute forms of toxic jaundice during the late stages.

Aplastic anemia was the first form reported, but subsequent studies seem to indicate that only a comparatively small number of cases are of this type. The blood picture was characterized by severe anemia with a high color index, by the absence of nucleated red cells and poikilocytes from the circulation and by an extreme leukopenia with a relative lymphocytosis. Purpura was a commonly associated condition.

Six autopsies on aplastic anemia due to T.N.T. have been reported. The bone marrow of these cases was either gray or fatty with areas of hemorrhage. The livers were generally not necrotic to the extent seen in toxic jaundice but showed extensive deposits of hemosiderin.

Toxic anemias of varying grades, ranging from mild changes in the appearance of the red cells and the decrease in the amount of hemoglobin to very severe anemia presenting a picture similar to pernicious anemia, have been reported by M. J. Stewart (19), L. H. Smith (23), Gregorson and Taylor (24), and by Minot (25). Minot's findings are very interesting in comparison with the experimental work and a fuller discussion of his results will be made later.

Experimental Anemia

The literature on experimental T.N.T. anemia is very meagre. Panton (7) reported an attempt to produce an aplastic anemia in guinea pigs by means of an injection of T.N.T. suspended in oil. He obtained negative results. Voegtlin *et al.* (11) described anemia as a constant finding in the dogs which they used in their work for the United States Public Health Service investigation. They summarized the blood findings in the animals as being a reduction in the total blood volume, a decrease in the red corpuscle volume and in the hemoglobin. They found an increase in the number of reticulated cells and in the number of nucleated forms, and mentioned the great inequality in the size of the erythrocytes.

In making routine blood counts on the animals in which we were studying the liver lesions it became apparent that the guinea pigs developed a severe anemia in almost every instance. We then decided to run additional series of both guinea pigs and rabbits for the special study of the blood changes. We knew from our work that the blood changes were fairly constant so that we felt that a small series of animals carefully followed was of more value than a large group which would be less tangible. In the rabbit series we used seven animals and several controls. Two were fed T.N.T., two were injected subcutaneously with T.N.T. in oil, two were injected intravenously with human serum saturated with T.N.T., and one was injected with salt solution saturated with T.N.T. After several doses the two animals which received serum died from anaphylaxis so that a new group of four rabbits was given the same treatment. These animals were given from four to nine intravenous doses, varying from 10 to 15 c.c. each, and none of them showed any blood destruction by blood count. The feeding animals developed a mild anemia, so that eventually all of the rabbits were fed T.N.T. and their bloods again studied. In rabbits the blood changes were inconstant and never severe. Usually the rabbits died from general toxemia before blood destruction advanced to any great degree.

The guinea pigs, on the other hand, showed early anemia which progressed to an extremely severe stage, and the changes were essentially the same for each animal. Ten guinea pigs and a control were used in this series. The animals were given T.N.T. by mouth until the blood changes appeared, and were then rested for several days, and the administration resumed. It was hoped by this procedure to exhaust the bone marrow and secure an aplastic form of anemia. At first the blood of several of the animals was counted on alternate days but later the counts were made only when the animals showed signs of toxemia and then the counts were made by heart puncture so that plenty of blood for fragility tests could be quickly obtained. The evidences of blood destruction became apparent in from three days to two weeks. When the anemia appeared early the animal was at

once rested and generally recovered, but when the symptoms were late the animal usually sickened rapidly and died, apparently from a cumulative effect. Two animals in which the blood counts were as low as two million recovered when rested.

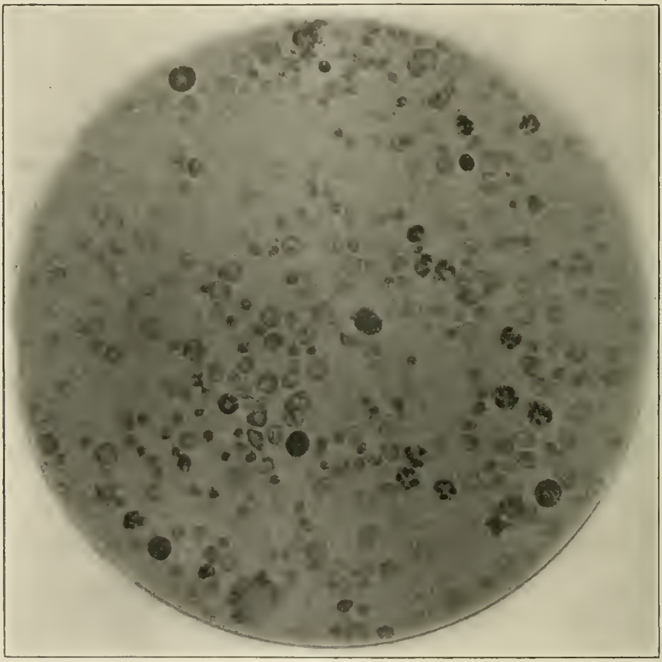

FIG. 3. — Photograph of blood smear from guinea pig poisoned with T.N.T., showing intense blood destruction. The field shows the great variation in the size of the red cells, numerous poikilocytes and several nucleated forms. Red cell fragments are also seen.

One of these two animals recovered rapidly. His count increased from 1,800,000 red cells to 3,600,000 in five days. The following synopsis indicates the changes observed in the blood:

Hemoglobin. — Estimations of hemoglobin were made with the Sahli hemoglobinometer. The old standard was used and the direct readings taken. The hemoglobin readings on unused animals ranged from 90 per cent. to 115 per cent. and on animals in the stage of poisoning from 35 to 50 per cent. One animal fell as low as 30 per cent. during the agonal period.

Red Cell Counts. — Counts on unused animals ranged from 4,500,000 to more than 5,500,000. The counts in poisoned animals were generally below 2,500,000. The lowest count was 1,200,000 cells.

Color Index. — The color index was greater than 1 in every instance after the number of cells fell below 2.5 millions. Indices ranging from 1.09 to 1.7 were found. The relatively high hemoglobin readings were probably due in part to the presence of abnormal hemoglobin combinations in the serum, as it is probable from the urinary findings that methemoglobin was present.

Abnormal Red Corpuscles. — During the severe toxic stage of poisoning, every guinea pig developed an anemia accompanied by the appearance in the circulation of all of the commonly recognized forms of abnormal red cells. Red-cell fragments were seen in practically every field in the advanced poisonings. Poikilocytes were making the differential counts the number per hundred white cells was recorded. The highest number of normoblasts was 54, and of megaloblasts was 9 (see Table 1). Several different types of nucleated red cells were present; ordinary normoblasts were in the majority; large nucleated forms, much larger than normoblasts, came

TABLE 1. — BLOOD FINDINGS IN ANIMALS POISONED WITH T.N.T

	Severe T.N.T. Poisonings								Recoveries		Second Poisonings	
Animal Number	IA	I	II	III	IV	V	VI	VII	IV	VII	IV	VII
Per cent. hemoglobin (Sahli)	40	35	55	...	45	...	30	46	80	100	35	35
Red count in millions	1.7	1.6	2.7	...	1.8	...	1.2	1.4	3.6	4.6	1.5	2.0
White count in thousands	30	47	13	...	9	...	89	74	12	9	15	23
Polymorphonuclears	42	56	20	55	54	67	55	67	66	30	67	47
Lymphocytes	52	30	61	31	29	23	25	22	30	54	18	43
Eosinophiles	3	9	5	3	0	0	11	2	1	6	0	0
Basophiles	1.5	0	1	0.5	0	0	1	0.5	0	3	0	1
Large mononuclears (non-granular)	0.5	2	7	2.5	12	2	2	13	3	0	6	5
Large mononuclears (granular)	0	2	4	3	2	0	3	0	0	1	9	4
Myelocytes	0	0	0	0	3	8	3	4	0	0	0	0
Normoblasts per hundred	21	42	7	52	15	14	7	55	2	1	30	4
Megaloblasts	0	3	2	6	9	8	2	17	0	0	17	3
Multinucleated red cells	0	0	0	5	3	2	0	0	0	0	0	0
Poikilocytes	++	+++	+	++	++	++	++	++	0	0	++	++
Macrocytes	++	+++	+	+++	+++	+++	++	++	0	0	++	++
Microcytes	+	+	0	+	+	+	++	++	0	0	+	+
Polychromatophilia	++	+++	++	+++	+++	+++	++	++	0	0	++	++
Stippling	0	0	0	0	0	++	0	0	0	0	0	0
Per cent. reticulated cells	....	....	....	....	61	58	78	....	3?	2	50	17

Few = +. Moderate Number = ++. Many = +++.

numerous and made up a large percentage of the cells. Macrocytes were so numerous that practically every field contained several. Microcytes were present but were relatively uncommon.

Inequalities in staining of the red cells were very common. In some of the animals there appeared to be almost as many cells showing polychromatophilia as those which took the ordinary eosin stain. Anisochromia was much less marked and stippling was seen only in the cells of one animal, but in this instance it was well marked and unmistakable.

Nucleated red cells were very common, occasionally four or five to a field. In next; and only a few microblasts and Howell-Jolly bodies were seen. Some of the large nucleated forms were unusual in appearance, their cytoplasm being grayish-blue, like the darker of the polychromatophilic cells, and their nuclei being made of loosely woven coils of deep blue chromatin substances with orange-colored material appearing between the strands. Red cells with two and even three nuclei were found in the smears.

Reticulated Red Cells. — A drop of fresh blood was allowed to flow, or drop, into about an equal part of 1 per cent. brilliant cresyl blue solution, made up in physiological salt solution. After about two

minutes a small drop of the mixture was placed on a slide and immediately examined, and smears were made on cover slips for permanent mounts. The latter were allowed to dry in the air and were then counterstained with Wright's stain in the usual way and mounted in balsam. Counts were made on the permanent smears and the relative number of reticulated and non-reticulated cells determined. Unless a large number of red cells are counted the method does not always give accurate results, because there seems to be a tendency for the reticulated forms to occur in groups. Severely poisoned animals showed from 30 to 78 per cent. of reticulated cells. The increase occurred during the poisoning stage and the reticulated cells became less numerous as the animal recovered. When T.N.T. feeding was resumed the percentage of reticulated cells again increased.

White Blood Cells. — During the poisoning stage most of the animals showed an increase in white cells. One animal gave a count of 89,000 and another of 76,000, but the average was between 15,000 and 20,000 and some did not go above 10,000. Differential counts were of little value save as a guide to the number of nucleated red forms present. In the two high counts, polymorphonuclear leucocytes predominated; in practically all of the other instances there was a lymphocytosis up to 50 or 55 per cent. The counts are more fully shown in Table 1.

In two of the animals there were unidentified small ring-shaped bodies which stained with eosin and contained bits of bluish or greenish chromatin material.

Fragility Tests. — The red blood corpuscles of normal and poisoned guinea pigs were tested for comparative fragility in hypotonic salt solutions. The blood was withdrawn from the heart and washed once in 0.5 per cent. sodium citrate in physiological salt solution. The suspension was then brought up to the volume of blood originally withdrawn and 0.015 c.c. of the suspension added to each tube of hypotonic salt solution. The hypotonic solutions decreased by 0.025 per cent. from 0.800 per cent. to 0.200 per cent., and 1 c.c. was used in each tube. In a series of normal animals, the first traces of hemolysis began at about 0.575 and was complete either at 0.475 or 0.450. Similar tests were made on the blood of poisoned animals at a time when their symptoms were very marked and in each instance hemolysis appeared between 0.600 and 0.800 and was not complete even in 0.200, apparently indicating that the blood at this time contained cells both of greatly increased fragility and of greatly increased resistance. Two of the animals recovered from the acute condition and their resistance was then found to be increased so that the range was 0.450 to 0.350, instead of 0.575 to 0.450. When they were again fed T.N.T., their blood reacted as it had during the first poisoning — namely, beginning hemolysis between 0.700 per cent. and 0.800 per cent. and incomplete in 0.200 per cent. salt solution.

Effect of T.N.T. on Red Cells in Vitro. — Blood serum and physiological salt solution which have been saturated with T.N.T. do not hemolyze red blood cells *in vitro*. Sets of tritrations were run, using physiological salt and normal serum, saturated with T.N.T., in contact both with normal corpuscles and with corpuscles from poisoned animals; also, with serum from one poisoned animal to which T.N.T. was artificially added in contact with cells from normal and poisoned animals. No hemolysis occurred. Very faint traces of bile added to the titrations produced hemolysis, but bile is itself a hemolyzing agent.

Effect of T.N.T. in Blood Stream. — Repeated intravenous doses of serum and salt solution saturated with T.N.T. did not produce hemolysis in rabbits, nor any other

demonstrable effects upon the blood, or bone marrow.

Summary of Findings in Anemia. — The feeding of T.N.T. to guinea pigs produces a severe anemia not unlike pernicious anemia, which is apparently due to the destruction of blood in the circulation and which is unaccompanied by destructive lesions of the bone marrow. The hemolysis is not due to the direct effect of T.N.T. on the blood because T.N.T. does not cause hemolysis either *in vitro* or when injected directly into the circulation. The anemia has a 1+ color index, is characterized by the presence of all sorts of abnormal red cells in the circulation, and is generally accompanied by a lymphocytosis. The nucleated forms are present in the greatest numbers during the periods of feeding and almost disappear when the animal is rested. Reticulated cells also become much more numerous as the severity of the poisoning increases, and disappear as recovery takes place. Severe poisonings increase the resistance of the red cells to hypotonic salt solutions. All of the experiments produced a hyperplastic form of anemia without evidence of bone marrow exhaustion. Some animals were repeatedly poisoned for nearly five months and finally died of the poisoning without evidences of bone marrow aplasia. Prolonged poisoning with small doses was found impractical because of the cumulative effect of the drug.

Discussion of Findings in Anemia. — Generally speaking, the blood changes in the guinea pig experiments were in accord with those found by Minot (25) in his study of the blood of 233 trinitrotoluol workers. The findings in his group of thirty-three workers with severe blood changes were very similar to the changes in the animals during the severe toxic period. In both instances there was blood fragmentation, polychromatophilia, anisocytosis, lymphocytosis, the appearance of nucleated cells, and a great increase in reticulated forms. We were able to produce severe anemias and to poison repeatedly some of the animals, two of which were studied for five months, and yet the reaction was first and last a hyperplastic type of anemia. It is possible that the bone marrow could be exhausted in time and an aplastic form produced if we could graduate the doses accurately and eliminate cumulative action, but in our series there was no indication of aplasia. On the other hand, it is possible that other factors in addition to the T.N.T. poisoning may enter where aplastic forms occur — as for instance, a collateral infection of the blood stream, bone marrow, or some local focus of toxin production.

Discussion of Pathogenesis of T.N.T. Poisoning. — Trinitrotoluene is readily absorbed through the skin and along the alimentary tract. It may be excreted in the urine and to some extent in the bile as shown by the presence of Webster-positive substances. Though not a hemolytic agent when added to blood outside the body, continued absorption of it by the body leads to very evident blood destruction. This is shown by the decrease in the number of cells per cubic millimeter, the fall in the per cent. of hemoglobin, the presence of polychromatophilic cells, the phagocytosis of red blood cells by endothelial leucocytes (particularly noticeable in the spleen), the accumulation of hemosiderin in the liver and spleen, and by the appearance of bile in the urine. The mechanism of the initial hemolysis is uncertain, though it is probably associated with the formation of methemoglobin. Methemoglobin was not demonstrated in the early stages, but cyanosis was present, and the later finding of methemoglobinuria makes it the most likely cause of the interference with the oxygen-carrying power of the blood. It is probable that, in the animal work, excessive hemolysis once begun led to free hemoglobin in the blood stream, which, in turn,

acted to increase the secretion of bile (26). Later, the bile was found in abundance in the blood stream, and furnished another hemolyzing factor to augment the hemolysis. The bone marrow then became very active in order to compensate for the red cell destruction and many immature blood cells were thrown into the stream. If T.N.T. was removed at this time the bone marrow soon caught up, and recovery took place, but if T.N.T. absorption continued, the whole process became aggravated, visceral changes developed, and the condition advanced rapidly to a fatal termination.

Several factors may have united to bring about the development of the liver lesions. The liver necroses were so constant and so typical within certain limits, as to make it appear that T.N.T. exerted an almost specific influence on liver tissue. While it is possible that the lesions were due in part to the hyperactivity of the liver parenchyma, coupled with gradual asphyxiation due to the impaired oxygen-carrying powers of the blood, it is hard to rule out the direct action of T.N.T. because the bone marrow and kidneys were subjected to similar asphyxiation, were also forced to hyperactivity, and yet showed no comparable lesions.

There were no evidences of bone-marrow destruction in any of the animals, not even in those which had received intravenous injections. The nucleated red cells increased during the acute toxemic stages, and decreased during the resting or regenerating stages, just as Bunting (27) found in his animals after the intravenous injections of saponin, etc. He attributed the reaction to the destructive lesions of the marrow produced by the poisons, but it is obvious that his explanation is not applicable in our series.

The hyperplasia of the spleen was associated in some way with the excessive hemolysis. This is shown by the large amounts of blood pigment found in the spleen sections. The hyperplasia was accompanied by the appearance of large endothelial leucocytes filled with phagocyted red blood cells, nucleated red cells, fragments of red cells and blood pigment. We think it more likely that these large cells played a passive part, by phagocyting red cells, etc., already injured, than that they actively destroyed them.

The kidney lesions appeared to be of a toxic nature and probably were due, in part, to the excretion of toxic T.N.T. products and, in part, to the effect of the general asphyxiation on the renal tissue. During the later stages, hemoglobin, methemoglobin, and bile were excreted in addition to the Webster-positive substances. The final interference with kidney function played an important part in the fatal termination of the poisoning.

No hemorrhages, such as were seen in the clinical cases, were found in the animals.

Summary. — The chief factors leading to the terminal pathologic findings appeared to be hemolysis, probably associated with the formation of methemoglobin, hypersecretion of bile, general asphyxiation of all tissues, direct toxic action of T.N.T. on the liver, bone marrow hyperplasia, and final failure of kidney function.

Conclusions

1. Trinitrotoluene fed to rabbits and guinea pigs or rubbed into their skins, produces liver lesions similar to those found in human cases of T.N.T. toxic jaundice.

2. Methemoglobin appears in the urine of some animals experimentally poisoned with T.N.T., during the late toxic stages.

3. T.N.T. fed to guinea pigs produces a very severe anemia. The anemia is hyperplastic in type, has a +1 color index and is accompanied by the appearance in the circulation of all types of nucleated red cells and by an increase in the number of reticulated cells.

4. Experimental anemia in the guinea

pig, due to T.N.T. administration, presents the picture of a so-called primary anemia, but appears to be due entirely to blood destruction in the circulation, since repeated histologic examinations of the bone marrow failed to reveal any destructive lesions of the blood-forming centers.

5. The resistance of the red corpuscles to hypotonic salt solutions was found to be increased after the animals had recovered from severe poisonings.

6. Removal of the animals from exposure to T.N.T. usually led to complete recovery, even though a high degree of anemia had developed.

7. The similarity of the experimental findings to the blood changes in employees described by Minot, emphasizes the importance of thorough blood studies in instances of suspected T.N.T. poisoning. The hopeful prognosis in animals brings out the importance of early diagnosis and immediate removal of anemic persons from contact with T.N.T.

In closing the author wishes to express his thanks to Dr. T. McC. Mabon, who made many of the routine blood examinations, and to Dr. S. S. Waddell for her assistance in carrying out a number of the chemical tests.

BIBLIOGRAPHY

1. Spilsbury, B. H.: Demonstration of a Series of Livers Affected by Toxic Hepatitis. Lancet, 1916, **1**, 999.
2. Thursfield, H.: Note upon a Case of Jaundice from Trinitrotoluol Poisoning. Brit. Med. Jour., 1916, **2**, 619.
3. O'Donovan, W. J.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 73.
4. Martland, H. S.: Trinitrotoluene Poisoning. Jour. Am. Med. Assn., 1917, **68**, 835.
5. Moore, B.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 37.
6. Feldman, I.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 67.
7. Panton, P. N.: The Effect of Trinitrotoluene upon the Blood. Lancet, 1917, **2**, 77.
8. Haythorn, S. R.: The Pathology of Trinitrotoluene Poisoning. Internat. Assn. of Med. Museums, Bull. No. 7, 1918, p. 103.
9. Haythorn, S. R.: Experimental Trinitrotoluene Poisoning, read at Eighteenth Annual Meeting of American Pathologists and Bacteriologists, April, 1918.
10. Smith, G. C.: Trinitrotoluenes and Mono- and Dinitrotoluenes, their Manufacture and Properties. New York, D. Van Nostrand Company, 1918.
11. Voegtlin, C., Hooper, C. W., and Johnson, J. M.: Trinitrotoluene Poisoning. U. S. Pub. Health Rep., 1919, **34**, 1307.
12. Putnam, T. J., and Herman, W.: A Study of Fifty Workers in Trinitrotoluene. Jour. Indust. Hyg., 1919–1920, **1**, 238.
13. Matthewson, F. W.: Personal Communication.
14. Wagner, J. H.: Bronchiolitis Obliterans Following the Inhalation of Acrid Fumes. Am. Jour. Med. Sc., 1917, **154**, 511.
15. White, R. P.: Some New Forms of Occupational Dermatoses. Lancet, 1916, **1**, 400.
16. Livingstone-Learmonth, A., and Cunningham, B. M.: Observations on the Effects of Trinitro-toluene on Women Workers. Lancet, 1916, **2**, 261.
17. British Ministry of Munitions: Trinitrotoluene Poisoning. Lancet, 1916, **2**, 1026.
18. Spilsbury, B. H.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 41.
19. Stewart, M. J.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 10.

20. Oertel, H.: The Anatomical Findings in Trinitrotoluene Poisoning. Canad. Med. Assn. Jour., 1917, **7**, 281.

21. Turnbull, H. M.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 47.

22. Panton, P. N.: Special Discussion on the Origin, Symptoms, Pathology, Treatment, and Prophylaxis of Toxic Jaundice Observed in Munition Workers. Proc. Roy. Soc. Med., 1916–1917, **10**, Part 1, 44.

23. Smith, L. H.: The Blood of Workers in Trinitrotoluene. Jour. Am. Med. Assn., 1918, **70**, 231.

24. Gregorson, A. W., and Taylor, F. E.: On Trinitrotoluene Poisoning, with Records of Five Cases. Glasgow Med. Jour., 1918, **90**, 65.

25. Minot, G. R.: Blood Examinations of Trinitrotoluene Workers. Jour. Indust. Hyg., 1919–1920, **1**, 301.

26. Howell, W. E.: A Textbook of Physiology. Sixth Edition. Philadelphia, W. B. Saunders Company, 1914, p. 819.

27. Bunting, C. H.: Experimental Anaemias in the Rabbit. Jour. Exper. Med., 1906, **8**, 625.

BOOK REVIEWS

Lectures on Industrial Psychology. By Bernard Muscio, M.A. (Sydney); M.A. (Gonville and Caius College, Cambridge); Late University Demonstrator in Experimental Psychology, Cambridge; Sometime Acting Lecturer in Mental and Moral Philosophy, Sydney. Cloth. Pp. 300 with illustrations and index. New York: E. P. Dutton and Company, 1920; London: George Routledge and Sons, Ltd., 1920.

This book, divided into five lectures, is well written and contains a wealth of interesting illustrations from actual field work in psychological problems related to industry.

Muscio defines psychology as "accurate and systematic knowledge about the mind" and proceeds to show that, although the application of psychology to industry is still very limited, there is a considerable body of fairly precise psychological knowledge which is relevant to industry. In medicine, education, and law such knowledge has been used extensively for some time. The reason for applying psychology to industry is to further the aim of industry, which is to produce the material goods required by civilized man in the most economical manner possible, by (a) selecting workers on the basis of natural fitness and (b) constructing good methods of work for the purpose of obtaining from any expenditure of human energy or effort a maximum production. From the standpoint of the employer, the maximum production is to be obtained from a fixed amount of human energy. From the standpoint of the employee, the quantity of production is more the fixed quantity, and is to be obtained from the minimum expenditure of human energy. The suggestions offered by industrial psychology can be carried out by one who regards the question from either point of view.

It is clearly stated that there is no similarity whatever between industrial psychology, as above defined, and speeding up, which is "the attempt, by offering incentives of one kind or another to the will, to induce operatives to expend more than the greatest reasonable amount of energy in a given time."

The second lecture takes up mental factors relevant to industry. First, the nature of fatigue is discussed from its physiological and psychological aspects, and some present industrial causes of fatigue are considered, with the effects of fatigue upon industry. For example, the influence of fatigue upon the quantity and quality of output is an important consideration, and many figures are shown and analyzed in connection with the shortening of working hours, industrial accidents, and production. Suggestions for decreasing industrial fatigue are given, for "the elimination of industrial fatigue will render possible for the industrial worker a mental and bodily condition which, though not constitutive of, is nevertheless prerequisite for, an ideal social life."

Not only by shortening hours is fatigue to be reduced but by better muscle co-ordination and by constructing good methods of work, e. g., so that as much use as possible shall be made of similar groups of muscles exercised simultaneously on the two sides of the body.

Lecture III discusses the selection of workers on the basis of natural fitness. Psychological work in this field has been done since 1909, although Taylor applied the principles forty years ago. Two main principles of selection are in use: (1) the *each-capacity principle*, in which the applicant is given a number of tests to find out his capacities in various lines thought to be relevant to the work applied for; and (2) the *central-capacity principle*, where one test is constructed which elicits the ability of the individual to perform in the laboratory a complex task psychologically similar to the work. The practicability of the theory of selection is clearly shown, although it is recognized that adult workmen trained in work for which they were never naturally fitted would have a legitimate objection to being tested and forced to change their vocation. On the other hand, there are no difficulties, except conservatism, in the way of applying the principle of selection to boys and girls who are about to become wage earners.

In the fourth lecture scientific management, "Taylorism," and industrial psychology are compared. When scientific management is at its best, its three main tasks are: (1) to determine scientifically the best possible conditions of work; (2) to induce workmen to accept the conditions of work that have been proved scientifically to be best; and (3) to teach workmen the new work methods devised as part of the best possible work conditions. Thus, the aim of scientific management is to obtain the greatest possible adjustment, and in this attempt industrial psychology becomes relevant to it.

Cases are given to show how new methods of work have decreased the labor and increased output; for example, the introducing of pauses into monotonous and tedious work, the substituting of automatisms for frequent acts of decision, and the modification of the actual movements of the workmen. Thus, industrial psychology has its place in scientific management.

The last lecture is on the desirability of applying psychology to industry, the chief points being as follows:

"We have been concerned with the question whether the application of psychology to industry is desirable. In considering this question, it was found advisable to discuss scientific management similarly, since it is only in connection with scientific management that psychology has been, or is likely to be, applied to industry. From a cursory examination, it seemed that the only persons who might find the application of psychology to industry undesirable were industrial workers. The answer to our main question thus required an analysis of the whole situation from labour's point of view.

"In the course of this analysis, we discovered that, without exception, all labour's important objections to industrial psychology were really directed against the method by which it had been put into practice. Certain of labour's objections, it is true, seemed to rest upon confused thinking; but there were two — the autocratic tendency of scientific management, and its relation to collective bargaining — which seemed based upon undoubted fact. It seemed, also, that labour's hostility, so far as it was based upon these two objections, was not unreasonable. If the matter had ended there, we should have been forced to the conclusion that, for labour, at least, the application of psychology to industry is undesirable.

"This, indeed, is where the matter rests at the present moment. Looking ahead, however, we see that certain modifications in the method by which the application of psychology to industry is made, are possible. These modifications consist in a further democratisation of workshops, and in offering to labour, perhaps in the form of a shorter working day, a larger share of the new profits than has hitherto been given it.

"If these modifications were introduced, the application of psychology to industry would probably seem to labour highly desirable, and the worker would be as eager as anyone to adopt the new discoveries. For the aim of labour is to increase its share of common human goods. Such an increase, of course, is not secured by simply increasing the productivity of the human energy expended in industry; but while this is obvious, it is equally obvious that the greater the profits the greater the possible share of them for labour. . . . If, then, labour's protective rules and institutions were safeguarded and if an unambiguous and considerable share of the new profits were accorded it, there seems no doubt that it would find the application of psychology to industry very desirable. . . .

"I shall conclude by emphasising the great fact about which these lectures have centred. This is that, by certain applications of psychology to industry, it has been found possible to obtain a given output from a much smaller expenditure of human energy than that hitherto necessary. This, I think, is a great fact: it is for men to say how they will use it. Psychology has now to turn to its laboratories again. Its task is to better what has been done. To devise practical methods by which its results, and those of other sciences, may be available for the enjoyment of all, is the task of society in general, and especially of labour and capital." — *Stanley Cobb.*

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | JANUARY, 1921 | NUMBER 9

EMPLOYMENT AND THE DISTRIBUTION OF INDUSTRIES IN THEIR RELATION TO THE GROWTH AND PHYSICAL DEVELOPMENT OF THE YOUNG WAGE EARNER *

HARRY J. WILSON, O.B.E.

H. M. Superintending Inspector of Factories for Scotland

During a period extending over twenty-seven years spent as an inspector of factories in various parts of England and Scotland I have throughout been constantly impressed with the variation in physique of the industrial population. From the beginning I was struck with the obvious stunting in growth and the prevalence of marked deformities, usually due to rickets, in the larger industrial towns, and, on the other hand, equally impressed with the fine, well-set-up workers employed in outdoor occupations, and living in rural surroundings. This contrast in physique was noticeable in men and women alike. At first I was inclined to attribute the disparity in growth to the nature of the employment, but on measuring and weighing numbers of adolescents employed in textile factories in a large town, and an equal number similarly occupied in a country district within the same county, I found that, though there was marked deviation from the normal in the case of the city young people, the country workers were rather above the average in both height and weight. As in both cases the conditions of employment were identical, the hours exactly similar, I was satisfied that the causes of degeneracy lay outside occupation almost altogether, and were obviously related in some way to home conditions. These were utterly different in the cases under review; the country young people lived in good cottage homes, had every appearance of being well fed and looked after, whereas the city workers were drawn from one or two-roomed, squalid tenement houses in a congested area of a manufacturing town, and bore evidence of neglect in their clothing and general appearance. Subsequent investigations have all tended to confirm this impression.

The subject is not, however, so simple as it at first sight appears, for the following reasons. Occupation has a selective effect on its recruits; the delicate, the weakly, the deformed — all, in fact, who are conscious of some physical handicap drift into such callings as make small demand on bodily strength or endurance. Thus, a large proportion of lame, weakly, and ill-developed persons will be found in sedentary occupations or light work. On the other hand,

* An address delivered at the Congress of the Royal Institute of Public Health held in Brussels May, 1920. Received for publication Aug. 23, 1920.

employment which is exacting in its demand on physical fitness and endurance finds recruits among the strong, robust and enterprising young people. No man, for instance, could long follow the calling of a miner unless he was physically fit. At first sight, therefore, it might be argued that the light indoor occupations had an injurious effect on the health and growth of the persons engaged in them, judging by the appearance of the workers and, similarly, that heavy trades — that is, iron and steel manufacture, mining, navvy work, etc. — were necessarily advantageous, inasmuch as the employees appeared physically excellent.

Without doubt, practically every type of occupation, if persisted in long enough, has some definite effect on health; but, confining ourselves for the present to the question of growth, it is obvious that industrial employment can affect it but little if the worker commences wage earning in any particular industry when he is almost full-grown. The very important period is from infancy to 16 or 17 years of age. Among the industries which require sterling health and muscular strength I would place blast furnaces, the laboring departments of iron and steel rolling mills, the heavy chemical trades, cane-sugar refining, and navvy work, and these the employee usually enters over the age of 18, in many cases over 20. It is found that these trades draw their workers largely from agricultural districts; in other words, the men have been born and reared in rural areas and have attained good height and development before taking up industrial work at all.

Home conditions, which I hope to prove are the determining factors in influencing growth and even health in the young, are largely, but not entirely, dependent on the parents' wage. The wages hitherto paid in rural districts have been considerably lower than those prevailing in towns, yet notwithstanding the small remuneration, country parents appear able to rear families which in stature and weight approach closely the physique of the most favored classes, and easily outstrip those of urban origin. This superiority of physique, in spite of low wages, is partially explained by the fact that the rural children are constantly in the open air and benefit by sunshine; there is generally a garden attached to the home which produces vegetables and some fruits; and if the parent maintains a cow and poultry the children are assured of the essential foods which, though easily procurable in country districts, are costly to purchase in towns. These advantages, then, the rural wage earner possesses over his colleague in the city, and they are of infinitely more value than is generally recognized.

In industrial centers, however, the wage is a predominant factor, determining among other things the locality the worker must live in, and the size of the house. The unskilled town laborer is as a rule the worst housed, and in my experience his children are the poorest in physique among all the families of the industrial classes. It is seldom that an unskilled laborer can afford to put his sons to any trade; their maintenance during apprenticeship is too costly. Consequently the sons of laborers tend to become laborers, they take up work which promises high pay in early youth, but as most such jobs are "dead end" in character, the men come on the market again later as general laborers. The position, then, of the unskilled town laborers in the past has been rather a hopeless one and it is not surprising to find the standard of health and physique low in their class. Confirmatory evidence of this is found again and again throughout the recently published report on the physical examination of men of military age by the National Service Medical Boards, 1917 to 1918. Thus, the average height of 230 Glasgow laborers examined for army purposes was 5 feet 2

inches and the weight 8 stone 12, the lowest of any occupational class brought under review. The figures show a deplorably low standard and are a severe reflection on the conditions under which the recruits were reared. In contrast to these and as showing the physical superiority of the country-bred man, the average height of 440 navvies measured by myself, all brought up in agricultural work, was 5 feet 8.8. inches (175 cm.), and the weight 12 stone 4 pounds (78 kg.). The heaviest of these men were from County Kerry; the tallest were natives of the North of Scotland. An inquiry I made into the diet of these rural workers proved that it was exceedingly simple in character, consisting largely of potatoes, oatmeal, milk, and cheese, with very little flesh food.

The stunting of height and undevelopment which is apparent enough during adolescence among poorer paid workers in industrial centers shows itself as a rule before the young person leaves school. The medical inspection of schoolchildren reveals this clearly enough, the deviation from the standard observable at 5 years of age becoming more marked as the child grows older, and at 13 years of age there is, in the case of Glasgow board schoolchildren, a difference of nearly 5 inches in height between them and corresponding young people in the North of Scotland, and a difference of almost 20 pounds in weight. Racial characteristics might to some extent account for these striking differences, but it appears to me that the real reason lies in the very favorable conditions under which the northern children live. Child neglect in rural areas is exceedingly rare. There is still a rather sterner training in character given by country parents, and the families not only prove physically superior, but seem to rise to positions of responsibility and trust wherever they go. The success of country-bred persons in city life has often been remarked; they are found asfinanciers, as leading professional men, as the heads of businesses, and as managers and foremen in industry. The managing director of one of the largest manufacturing concerns in England recently stated that in his experience the best foremen, with respect to the command of men, resource and engineering intelligence, have been country-bred boys, and that the best and steadiest workmen also come from the country.

If, then, rural conditions produce, as they appear to do, a race physically and mentally fit, showing a superiority over those born of parents possibly financially better off, but by the accident of birth condemned to spend the whole period of growth in the more or less unhygienic environment of industrial centers, it would seem desirable from every point of view that as large a proportion as possible of the population should live in rural areas. Unfortunately, however, the present tendency is toward greater concentration in industrial localities and a declining rural population. The urban population in the United Kingdom now accounts for 80 per cent. of the total inhabitants, and the urban is always growing at the expense of the rural. With this diminution of the country population there has been concurrently a closing-down and shutting-up of many rural industries, so that the modern tendency is still toward concentration of manufactures near the centers of population. This development of industry has in the past proceeded in a haphazard way, with no central authority controlling or taking any special interest in the matter. Consequently we find extraordinary congestion in certain areas of the country, and other localities equally neglected although affording good facilities for manufacturing purposes. Industries all dealing with the same material and employing a preponderating proportion of one sex have grouped themselves in certain towns and rendered general development difficult,

inasmuch as an industrial community to be economically sound should have a proper proportion of each sex employed. At the present time there are areas in the United Kingdom where the demand for female workers cannot be satisfied and yet where no employment is offered for men, and *vice versa*.

The difficulties would be overcome were industries better distributed, and distributed in such a way that the sexes would be adequately balanced. Thus, it has been found advantageous to have spinning and weaving, and the manufacture of hosiery in mining districts so as to afford employment for the daughters of pitmen, and equally desirable to have engineering and like trades in textile districts so as to afford employment for the heads of families, without which obviously there would be no successive generation of young people to staff the textile factories.

The establishing of new industries in rural areas is always attended by the initial difficulty of lack of trained labor on the spot, but recent practice on the part of certain large firms has been to erect houses for present and future workers, and when this is done almost ideal conditions can be secured. Indeed, a judicious pushing out into rural areas of industries planted in the midst of already congested towns would tend to solve automatically many pressing problems of public health. Judging by past experience, not only would the infantile death rate be lowered, but a healthier and better-grown race of young workers would be reared. Incidentally, I may mention that there appears to be some definite association between degeneracy in physique and a high infantile death rate. In rural areas, where the infantile death rate is usually very low, there the standard of physical fitness is high; in the textile towns of Lancashire where the infantile death rate ranks high, the standard of physique, judging by the conditions revealed in the medical examinations for military purposes, was almost uniformly poor. In the densely populated area of Lancashire and Cheshire, for instance, in which the textile industry predominates, out of 1,070 recruits of 18 years of age examined, no fewer than 451 (or 42 per cent.) were less than 112 pounds in weight and 142 of them (or 13 per cent.) were less than 100 pounds in weight. The chairman of the medical board in this region, commenting on the physical standard of recruits, remarks that the average person here is for military purposes an old man before he is 40. On the other hand, the proportion of Grade I recruits in agricultural areas is almost invariably high. This was the experience of the medical boards throughout England and Scotland. Miners reached almost the same standard, especially where the pits were located in rural areas and the recruits had been brought up in virtually agricultural conditions, many of the young miners being the sons of small farmers. This was particularly exemplified in the western portion of the Welsh coalfield.

The fine physique of the territorial Highland regiments, largely drawn from agricultural and pastoral districts, was generally recognized, and among our colonial troops the Australians — again a class chiefly engaged in outdoor callings — were remarked for their tallness. Further, our police force, which demands a high standard of stature and fitness in young men joining it, draws its recruits very largely from the class which follows the plough. Further examples could be given but these will suffice to prove that where early life is spent largely out of doors, as nature intended it should be, a good standard of height and weight is usually attained, even though the diet is simple in character and without much variation.

It has been demonstrated repeatedly that the physique of the moneyed and professional community is good, the standard be-

ing the best of all classes, and the reasons are fairly obvious. The children of this class are carefully nurtured, have ample sleep, outdoor exercise, and organized games, and a special interest is taken in their development and growth. Similarly, the children of skilled artisans, especially in towns, have advantages over the offspring of the poorer paid, unskilled city laborers, inasmuch as they benefit from the parents' higher wages and enjoy such hygienic conditions as the father's purse affords. The relative position of recruits drawn from this class is clearly shown; out of 40,000 examined in the London region, 37 per cent. were of Grade 1, while of those engaged in unskilled labor only 27 per cent. attained this standard, and the percentage suffering from specific disease was much higher than among those drawn from the skilled trades.

Until the last great European war there had never been any call to have an anthropometric survey of the young manhood of the nation, and the usual impression held by the public was that the physique appeared quite good and the general health equally so. Those who, like myself, came much in contact with the toiling masses of the large cities and noticed their stunted size and the extraordinary commonness of deformity, especially of the lower limbs, occasionally expressed doubt if all was well, but the community generally refused to admit any particular deterioration. The medical examination of all men drafted into the army, however, for the first time in our history, gave some definite idea as to how we stood. The conditions revealed must be considered as seriously disquieting so far as our own young manhood is concerned. As for women, there has unfortunately been no corresponding survey, but my own observations suggest — there are no figures at present available, and it is only my impression — that the conditions and environment, which adversely affect the healthy growth of men, have an equally injurious effect on women. In agricultural districts where the men are well grown, so are the women; in the densely populated manufacturing centers where the men are stunted in height and light in weight, the women correspond. This is as one would expect, as the sexes share in the home conditions, be they good or bad, and enter employment at much the same age. If anything, girls have less opportunity for open-air exercise during growth than boys, and while a small proportion of industries, open-air or partially open-air in character, are available for boys, most women's occupations are indoor, and a vast number sedentary in character.

Continental countries have for years had annual examinations of recruits drawn from all classes and have thus had an opportunity of estimating effects of town and country life and industry on the growth of the young manhood. The only figures I have seen, those relating to Germany, show very much the same results as are observed in the United Kingdom as regards the superiority of the agricultural classes over the city and industrial classes. When this was recognized in Germany efforts were made to attack the causes of deterioration and to encourage rural industries and agriculture so as to secure as large a proportion as possible of men of high military value.

It must be admitted that there has been lamentably little interest taken by the community generally in the physical fitness of the race. This seems somewhat extraordinary in a nation which has been phenomenally successful in the breeding of cattle, horses and sheep. The previous apathy must be put down largely to ignorance of the real conditions, and to the fact that prior to the late war the physical efficiency of the manhood of the country had never been severely tested. The vast majority of occupations make no searching demand on the stamina of the persons who follow them; there are usually light proc-

esses which can be carried on by weak or even slightly deformed operatives, and so long as the work is done and suitable labor is available there is no particular cause for comment. When, however, the whole future of the state depended, as it did, on the fighting efficiency of its armies, the health of each individual member assumed at once a position of the very highest importance, and now that this has been definitely realized, the physical welfare of any class, however humble, can never again be allowed to be a matter of indifference.

TABLE 1.—DIFFERENCES IN HEIGHT AND WEIGHT OF WORKMEN OF RURAL AND OF URBAN ORIGIN

Class of Men	Number Examined	Height in Feet and Inches	Weight in Stones and Pounds	Age
Country-bred men	440	5–8.8	12–4	20 to 55
Public school men, military cadets, etc.	proportion of 7,000	5–9.06	11–1.2	20 to 30
Sheffield grinders	1,080	5–4.55	9–10.13	25 to 55
Birmingham brass workers	500	5–6.6	9– 8.0	25 to 55
*Glasgow laborers	230	5–2	8–12	18 to 40
*Glasgow engineers	280	5–5	9–1	18 to 40
*Glasgow joiners	55	5–4	9–9	18 to 40
*Glasgow carters	37	5–2	9–3	18 to 40
*Manchester recruits (Grade 1)	1,000	5–5	8–8.6	Average 28
*Ashton-under-Lyne (Grade 1)		5–4	8–10.5	30
*Bolton (Grade 1)		5–4	8–13	23
*Liverpool (Grade 1)		5–5	9–0.5	23
*Preston (Grade 1)		5–5	9–0.8	28
*Bury (Grade 1)		5–5	8–13	29
*Accrington (Grade 1)		5–5	9–5.9	29
*Lancaster (Grade 1)		5–6	9–2	21
*Warrington (Grade 1)		5–5	9–2.8	23
*Chester (Grade 1)		5–6	9–3.9	25

* Army recruits, *Report upon Physical Examination of Men of Military Age* by National Service Medical Boards (Cmd. 504). Note the slight advantage the Chester and the Lancaster recruits possess in height over those from larger and more essentially manufacturing towns. The above figures relate to Grade 1 men; statistics relating to an additional 1000 Grade 2 men from the same towns show materially worse physique.

Industrialism, the source of most of our wealth and position in the world, has brought about conditions, so far as the laboring masses are concerned, very different from those which existed in our earlier history when agriculture was the chief occupation and the community was scattered in isolated farms and small villages. Indeed, our ancestors, without perhaps being aware of it, were working on almost ideal lines for securing a healthy race of men and women, the children always in clean air, fed on the simplest but most wholesome of food, and the vast majority of men occupied all their lives in outdoor work.

Disquieting as are the facts revealed by the examination of recruits in the United Kingdom, the future is not without hope. The public conscience has been awakened, the whole housing question is being attacked, the school age is being extended, and the hours of employment have already been reduced, affording more leisure, more opportunities for games and open-air exercise, and, perhaps most important of all, more sleep for the young. Undoubtedly, curtailed sleep in the past was a serious evil and was chiefly due to the unnatural hour (6 A.M.) of commencing work. Further, more holidays are being taken, wages are higher and notwithstanding increased cost of living, children are unquestionably being better clothed and better fed than they were prior to 1914.

If more industries would move out of the crowded areas and establish themselves in clean, wholesome surroundings, and take some responsibility for the comfortable housing of their employees, as certain enlightened firms have done, an improvement in physique of the next generation of young workers would certainly follow. Indeed, this improvement has already been clearly demonstrated where the garden-city idea, in association with industry, has been adopted.

Of statistics dealing with the physique of adolescents we have practically none, but as the adult represents the result of all the environmental influences, good and evil,

acting and reacting on him during his whole growing period, he may be taken as representative of his class.

In conclusion, therefore, I give a table combining statistics obtained from the medical examination of recruits, together with others collected partially by myself, which show differences in height and weight of workmen of purely agricultural origin who had spent the whole of their period of growth in rural districts, and craftsmen and laborers born and brought up in industrial towns. Special care was taken to insure that the country workers had in every case resided in rural districts until full-grown. Most of the number measured were employed as navvies, but a proportion were engaged in salmon-fishing combined with agricultural work, and a few, although brought up to farm work, were later employed as laborers in iron and steel works.

THE EFFECT OF THE INHALATION OF GASES*

G. A. WELSH, M.D.
Medical Officer to H. M. Factory, Gretna

DURING the course of employment in the manufacture of nitric acid and sulphuric acid and in the varied processes for which these acids are used in the manufacture of cordite, the operatives are exposed to the effects of inhaling gases and gaseous vapors. The gases and vapors met with in the various plants are: sulphur dioxide (SO_2), sulphur trioxide (SO_3), chlorine (Cl), nitrosyl chloride (NOCl), compounds of nitrogen and oxygen, chiefly nitrogen peroxide (NO_2), and carbon monoxide (CO) contained in producer gas. The vapors are sulphuric acid in the form of a mist and nitric acid in the form of a mist. There are also nitric acid fumes and sulphuric acid fumes from concentrated acids. Records of cases treated at H. M. Factory, Gretna, show 361 persons who suffered from gassing.

The effects of a gas or an acid mist vary according to the quantity inhaled. If a sufficient quantity is inhaled at one time the condition is properly called gassing. The signs and symptoms are acute and, except in the case of carbon monoxide, are, for the most part, due to the irritant action of the gas. There is another aspect, however, which must not be lost sight of. If the same gas or mist is inhaled in small quantities over a long period, it is capable of causing ill health. I propose to deal with these cases separately. They are cases of systemic poisoning and not gassing. I will also deal separately with carbon monoxide which is not an irritant gas like the others. There are of course differences in the effects produced in cases of gassing. Some workers stand larger quantities than others, the amount of effect varying, a high degree of resistance being reached in those who are thoroughly acclimatized to the work. A new worker is more readily affected than one who has been a year in the plant, and a foreman of long experience may be little affected by quantities which affect severely the other less acclimatized workmen. Striking examples of this are found in plants where the gases are highly irritant and where, owing to the nature of the operations, the gases are more frequently found in the atmosphere — e. g., nitric acid retorts, and the plants where concentrated acids are mixed for use in nitration. In this connection it is of great importance that every worker should be medically examined and classified for work. A man with weak eyes or who suffers from pharyngitis, laryngeal catarrh or any lung affection is not a suitable person for work in an acid plant. I have records of cases where the inhalation of a moderate amount of gas caused a severe attack of bronchitis in a person predisposed to it, and others where it directly caused a quiescent lung tuberculosis to become active.

Effects of Various Gases

Volume for volume the compounds of sulphur and oxygen are not so dangerous as the compounds of nitrogen and oxygen or the compound, nitrosyl chloride. Similarly, the vapors of sulphuric acid are not so harmful as those of nitric acid. A gas in an anhydride state does not affect the skin — e. g., sulphuric anhydride and nitrogen peroxide; it causes smarting of the eyes and lachrymation and acts on the mucous membranes of the mouth, naso-pharynx, larynx and bronchi. A gaseous vapor — e. g., sulphuric acid mist or nitric acid mist

* Received for publication June 21, 1920.

— in addition to affecting mucous membranes, informs you of its presence by irritating the thin epidermis on the face and back of the hands.

A person who is gassed by an irritant gas complains first that he has difficulty in inspiration. His inspiration is shallow and frequent and he coughs at once if he attempts to breathe deeply. With this there is breathlessness on any exertion and thumping of the heart on the chest wall. The patient says that his chest feels tight and there is also a feeling of constriction in the larynx. Soon he complains of dryness and burning in the pharynx and there is evidence of laryngeal irritation in the form of a short persistent cough. He develops a headache with throbbing over the temples, feels sick and in some cases actually vomits. He has an anxious expression, feels ill and has a full bounding pulse; cyanosis may show in the face and thumb nails. In the course of an hour or two there is a slight rise of temperature. Physical examination of the chest shows harsh vesicular breathing and occasionally there are some low pitched rhonchi; the heart rate is frequent and the sounds are accentuated. If it is a severe case, the extraordinary muscles of respiration are called into play. The severity of these symptoms varies with the amount inhaled.

In order to estimate the gravity of a case it is essential to know what is the substance causing gassing. With this knowledge and judging from the severity of the signs and symptoms, it is possible to give a fairly accurate prognosis in all cases except those of gassing by nitrogen peroxide and nitric acid mist. In the case of nitrogen peroxide and nitric acid vapors, one must be very guarded because the effects may be slight at the time and give no indication of the amount of damage done to the lung. A man gassed by these compounds may become suddenly ill some hours afterwards and develop acute capillary bronchitis of a suffocative variety with edema of the lung. Cases in which chlorine or nitrosyl chloride is the cause of trouble may appear very alarming at the time but one knows from experience that the chances are in favor of the signs and symptoms settling down, and recovery taking place. The urgency of the symptoms in these cases is due more to spasm than to tissue change. Expectoration of blood is a common occurrence in gassing. If the blood is small in amount and mixed with mucus it is not of serious import; it may persist for two or three days. A large hemoptysis is evidence of pre-existing lung mischief. In nitrogen peroxide cases, expectoration of a blood-tinged serous fluid is a grave sign, indicating capillary bronchitis with edema of the lung.

Severe cases of gassing are kept under observation in the rest room until all dangerous symptoms subside. In the majority of the cases the urgent symptoms subside in twenty-four hours; a few last for forty-eight hours. It is then a question of dealing with what is left, pharyngitis, laryngitis, bronchial irritation or bronchitis. For a few days the patient complains of being out of sorts, is restless, without appetite, constipated and sleepless. A patient with a moderately severe case of gassing which resolves without complications is able to return to work in from seven to ten days. Any complications — e. g., laryngitis or bronchitis — of necessity prolong the incapacity and render it unwise to return the operative to work until the condition has fully cleared up. I always give these patients a change of air and surroundings for a week before certifying them as fit to return to work.

Gassing with carbon monoxide presents a different picture, as carbon monoxide is not an irritant gas. It acts, as is well known, by combining with hemoglobin to form CO-hemoglobin, causing a deficient supply of oxygen to the tissues. Its affinity for hemoglobin is greater than that of

oxygen and, if present in the air breathed, its gradual absorption destroys oxyhemoglobin. All my cases, with the exception of two, inhaled the gas in small quantity and were not serious. The patients were working alongside of other workmen and their condition was recognized in the early stages. The patients in two serious cases inhaled the gas in a close space. They were working alone, and were found unconscious, one suffering from epileptic convulsions and the other from heart failure. The patient with heart failure was a chemist who walked out of his office which contained carbon monoxide into the cold air. Both men recovered.

Treatment of Gassing

Preventive

It is very important to acquaint the operatives thoroughly of the dangers they run by inhaling these gases. This is systematically done, and warning notices, especially in connection with nitrogen peroxide, are posted in the plant and incorporated in the workmen's book of factory rules.

The wearing of respirators by operatives was carefully considered, but after many trials it was discontinued. The operatives themselves do not like wearing respirators and as the cases of gassing are generally the outcome of some accident it is impossible to be sure that the operative will be wearing a respirator at the time of the accident. As an exception, there is one case I would like to mention — that of the nitrocotton dippers. They wear a simple respirator of moist cotton wool well over the mouth and nose. This traps the vapors from the mixed acid up to a certain point and the men feel the benefit of it, but it cannot be called an efficient respirator. Short of a self-contained apparatus, nothing has been found to trap nitrogen peroxide fumes efficiently. It sometimes happens that a building may rapidly fill with fumes as the result of an accident and for this emergency we use a self-contained apparatus, the Mecco. The principle of this apparatus is that for a known period the wearer is independent of the atmosphere round about him, oxygen is supplied from a cylinder and the carbonic acid in the expired air is removed by absorption with caustic soda. A number of operatives have been trained in the use of this apparatus and form what we call a rescue brigade. This brigade is used in any case where it is necessary for the workmen to be in the plant in the presence of dense fumes. It is also ready for an accident where workmen might be trapped by dense fumes and not be able to get out of the building. Fortunately, on only one occasion has its use been necessary.

First-Aid Treatment

The following instructions are printed in the factory rule book:

Nitrogen Peroxide Fumes. — To treat a person gassed with nitrogen peroxide fumes — remove at once to the fresh air and lay out flat. If a severe case the patient should be carried out and not allowed to walk.

Take care that the heat of the body is kept up by covering with blankets and, if need be, use hot water bottles.

One dose of chloroform solution should be given at once and the patient seen by a doctor as soon as possible.

N. B. — If there is a marked difficulty in breathing or if the face is dusky blue in color, oxygen should be administered at once.

Producer Plant Gas. — All workers are warned that carbon monoxide is one of the constituents of producer gas. When this gas is inhaled in a closed space it may cause serious illness in the worker.

A considerable quantity may be inhaled before its effects are produced and the worker may become unconscious without feeling much the matter beforehand.

Giddiness, shortness of breath on slight exertion, thumping of the heart and an unsteadiness in the legs are the symptoms which may first show themselves.

To treat a person gassed with carbon monoxide gas, he should be at once removed from the poisonous atmosphere but not brought suddenly in contact

with cold air, as this may produce a serious condition from heart failure. The person should not be allowed to walk but should be carried out into a pure atmosphere and kept warm with blankets and hot bottles. If the breathing is shallow or has stopped, artificial respiration should be at once begun and oxygen administered from a cylinder. The doctor should be informed at once of such an occurrence and unless the person is too seriously ill to be removed he should be taken to the first-aid station without delay.

In the first-aid boxes there are unit doses containing 20 drops of spirits of chloroform, 3 drops of liquor strychninae hydrochloridi and water to one tablespoonful, and Seidlitz powders. There is also placed in each plant an oxygen cylinder containing 20 feet of oxygen. These cylinders are easily manipulated, the reducing valve being opened by means of a wheel and the oxygen conveyed to the person by a rubber tube with a vulcanite mouthpiece. As a means of administering oxygen they are most efficient. In slight cases, a dose of chloroform mixture, followed by a Seidlitz powder and a few hours' rest is quite sufficient. If the case is more severe, the patient is taken up to the rest room and is put to bed and plenty of fresh air allowed to play round about him. His bodily heat is maintained by means of blankets and hot bottles until a state of mild perspiration is reached. Marked difficulty in breathing and cyanosis is treated by administering oxygen, a dose of chloroform mixture every four hours, and in the way of food nothing but hot milk is given. In the nitrogen peroxide cases, the administration of oxygen is continued until all signs of danger are passed.

Only one case of gassing has had a fatal termination. This was a man who was working in a closed space and inhaled the vapors of fuming nitric acid. He died from the effects of nitrogen peroxide. The report on the post-mortem examination follows:

External Appearances. — The body was that of a man about 5 ft. 9 in. in height, and was fairly well nourished. Post-mortem rigidity was present in a slight degree; post-mortem lividity was well marked over the dependent parts of the body. There were no marks or bruises.

Examination of the Respiratory Passages. — The larynx and trachea showed no abnormal change. The extra-pulmonary bronchi with the large and small bronchi in the lungs were the seat of congestion with patches of ecchymosis. There were numerous tough fibrous adhesions between the lungs and chest wall especially marked and widespread over the lower lobe of the right lung posteriorly. These adhesions were not of recent origin but were evidences of old inflammatory lesions. There was slight emphysema of the anterior margins of the upper lobes of both lungs. Both lungs were the seat of a severe acute bronchitis with edema and patches of hemorrhage into the lung substance. There was no sign of pneumonic consolidation but the lung substance was friable and had to a great extent lost its elasticity. A small quantity of serous fluid was present in both pleural sacs.

Examination of the Heart and Large Blood Vessels. — The pericardium showed no abnormal change. The right ventricle and auricle were dilated and filled with soft blood clot. The left ventricle and left auricle were contracted and empty. The superior vena cava, the inferior vena cava and the pulmonary artery were distended with soft clot and fluid blood. In short, the right side of the heart was dilated and the circulation in connection with it engorged. The valves of the heart showed congestion but there were no adhesions and the valves were competent. The heart muscle was very dark in color. The blood was dark purple in color showing marked evidence of deoxygenation.

Systemic Poisoning from Inhalation of Gases and Gaseous Vapors

From time to time examples of what are called systemic poisoning have come before my notice. This condition occurs in operatives who have never suffered from gassing but who from time to time have inhaled small quantities of fumes. I have no doubt, after careful inquiry, that it is the inhalation which causes the condition. A common history is that the onset was gradual, that the condition became worse after each successive inhalation and that eventually the patient became unfit for work. Such a patient is anemic, complains of headache, sleeplessness, loss of appetite, loss of energy and capacity to do work, and suffers from a torpid dyspepsia with marked flatulence and constipation. In treating these patients I have found that as long as they are kept at work no system of treatment benefits their condition. As soon as they are removed from work and sent for a change of air, very simple treatment puts them right. The most successful method of treatment for these patients is to put them on a light fluid diet and treat them with an alkaline saline mixture.

A number of patients suffer from acute gastro-enteritis due to inhalation of small quantities of gas. I have also seen operatives with numerous ulcers affecting the lips, buccal mucous membrane and pharynx. These ulcers are intractable and resist all forms of treatment as long as the patient remains at work; when he is removed from work a simple mouth wash suffices for their healing. A number of cases complain of naso-pharyngeal catarrh; this also resists treatment till the patient is removed from work, when simple methods clear up the condition. I have seen no cases which would lead me to say that this systemic poisoning results in any permanent form of incapacity. At no time have I seen cases in which jaundice was a complication nor have I seen any cases where the anemia was intractable.

The question of the effect on the teeth has come up from time to time and, after sifting every case, I have found no instance where the fact that men were working in an atmosphere of gases and vapors caused decay of sound teeth. On the other hand, evidence seems to show that in a tooth which is already diseased, the process of decay is more rapid. Operatives are warned in every case to pay especial attention to the cleansing of their teeth.

INDUSTRIAL TUBERCULOSIS AND THE CONTROL OF THE FACTORY DUST PROBLEM *

C.-E. A. WINSLOW, Dr.P.H.

Professor of Public Health, Yale School of Medicine, and Senior Sanitarian, U.S.P.H.S. (Reserve)

AND

LEONARD GREENBURG, C.E.

Assistant Sanitary Engineer, U.S.P.H.S. (Reserve)

PART I

Present Day Problems of Tuberculosis

IN the development of any science there are alternating periods of positive theoretical advance and negative critical reaction. Both are essential to sound progress; yet the critical phase is of necessity somewhat trying to the souls of those whose interest lies in the immediate practical application of scientific principles for the furtherance of the well-being of mankind.

Our knowledge of the etiology of tuberculosis is at the present time passing through such a period of sceptical criticism. We know that there are two distinct factors involved in the production of an active case of tuberculosis — the number and virulence of the army of invading germs, on the one hand, and the mysterious complex of physiological factors called vital resistance, on the other; but as to the relative significance of these two factors we find no general consensus of agreement. There are those who maintain that lowered vital resistance is the one supreme determining condition and that tuberculosis, among adults at least, is not, for practical purposes, to be considered as a communicable disease. There are other authorities who, with somewhat less valid reasons, exalt the part played by the invading organisms and would treat tuberculosis from an administrative standpoint, as nearly as public opinion will permit, as we treat smallpox or scarlet fever.

Even the remarkable decrease in the death rate from tuberculosis during the past half century is interpreted in the most diverse ways. We are told by some of those who hold the reaction of the human body to be the chief controlling factor that vital resistance has been increased with the general improvement in the social and economic conditions of civilized life, or that it has been intensified by a process of hereditary selection. The believers in the dominant importance of the invading microbe in the etiology of this disease suggest that it is the tubercle bacillus which has been modified to a lower degree of virulence by hereditary forces operating upon its germ-plasm.

These current theories are alike in only one respect. They all attribute the decrease in tuberculosis to more or less vague and mysterious forces, which are at present beyond the region of deliberate human control. Some of them will, no doubt, prove definitely constructive in the future; but at present they tend to a general scepticism in regard to our anti-tuberculosis program, without the concrete suggestion of any alternative methods of dealing with this vital problem.

To the sanitarian who is actively engaged in the daily struggle against preventable disease, it is a relief to turn to one phase of the tuberculosis problem where his feet rest on firm ground. In certain trades and occu-

* Received for publication Aug. 30, 1920.

pations we find a definite condition — the presence in the atmosphere of fine particles of mineral and metallic dust — so clearly associated with an enormous excess of respiratory mortality as to leave no reasonable doubt that the dust is the effective factor in causing the disease. The occupations so affected are, it is true, insignificant in the number of men employed as compared with the industrial life of the nation as a whole, yet it is encouraging to remember that there is at least one small field of the broad tuberculosis problem in which definite and practical measures of control can be made effective wherever it is determined to put them into force. The object of the present paper is to review the evidence which indicates a direct causal connection between atmospheric dust and industrial tuberculosis, and to point out the practical methods by which the hazards of the dusty trades may be practically controlled.

The Relation between Dust and Respiratory Disease in Certain Occupations

The excessive incidence of tuberculosis among workers exposed to the pernicious influence of certain types of atmospheric dust has been noted for centuries by students of industrial hygiene.

Georges Agricola in *De Re Metallica* (translated from the first Latin edition of 1556 by one of the greatest of present day Americans, Herbert C. Hoover, and L. H. Hoover) discusses the hazards of mining as follows:

> Where water in shafts is abundant and very cold, it frequently injures the limbs, for cold is harmful to the sinews. To meet this, miners should make themselves sufficiently high boots of rawhide, which protect their legs from cold water; the man who does not follow this advice suffers much ill-health, especially when he reaches old age. On the other hand, some mines are so dry that they are entirely devoid of water, and this dryness causes the workman even greater harm, for the dust which is stirred and beaten up by digging penetrates into the windpipe and lungs, and produces difficulty in breathing, and the disease which the Greeks call ασθμα (asthma). If the dust has corrosive qualities, it eats away the lungs, and implants consumption in the body; hence in the mines of the Carpathian Mountains women are found who have married seven husbands, all of whom this terrible consumption has carried off to a premature death. At Altenberg in Meissen there is found in the mines black pompholyx, which eats wounds and ulcers to the bone; this also corrodes iron, for which reason the keys of their sheds are made of wood. Further, there is a certain kind of cadmia [probably cobalt] which eats away the feet of the workmen when they have become wet, and similarly their hands, and injures their lungs and eyes. Therefore, for their digging they should make for themselves not only boots of rawhide, but gloves long enough to reach to the elbow, and they should fasten loose veils over their faces; the dust will then neither be drawn through these into their windpipes and lungs, nor will it fly into their eyes. Not dissimilarly, among the Romans* the makers of vermillion took precautions against breathing its fatal dust.

Ramazzini in his famous work on the *Diseases of Artificers and Tradesmen* (1700) states that stone cutters "oftentimes suck in, by inspiration, the sharp, rough and corner'd small Splinters or Particles that fly off; so that they are usually troubled with a cough, and some of 'em turn Asthmatick and Consumptive." He adds: "And in dissecting the corps of such Artificers, the lungs have been found stuffed with little Stones. Diemerbroek gives a curious Relation of several Stone-cutters that dy'd Asthmatick, and were open'd by him; in whose Lungs he found such heaps of Sand, that in running the knife through the Pulmonary Vesicles, he thought he was cutting some Sandy Body."

Thackrah in his treatise on *The Effects of the Principal Arts, Trades, and Professions on Health and Longevity* (Phil. Ed., 1831) emphasizes the seriousness of respiratory disease in various dusty occupations. He

* (Pliny, XXXIII, 40.) "Those employed in the works preparing vermillion cover their faces with a bladder-skin, that they may not inhale the pernicious powder, yet they can see through the skin."

states that miners in the north of England "suffer considerably when employed in ore in the sandstones, but are sensible of no inconvenience where the ore is in limestone." He cites a parallel condition among the grinders of Sheffield: "The fork-grinders, who use a *dry* grindstone, die at the age of 28 or 32, while the table-knife grinders, who work on *wet* stones, survive to between 40 and 50." Draw-filing of cast iron was at this time an exceedingly hazardous operation.

> The particles rise so copiously as to blacken the mouth and nose. The men first feel the annoyance in the nostrils. The lining membrane discharges copiously for some time, and then becomes preternaturally dry. The air-tube is next affected. Respiration is difficult on any increase of exertion, and an habitual cough is at length produced. At the same time, the digestive organs become impaired; and morning vomiting, or an ejection of mucus on first rising, is not infrequent. The disorder varies of course with the constitution of the individual; but the common termination, when men pursue the employment for years, is bronchial or tubercular consumption.

In more recent times, the statistics of industrial tuberculosis among steel grinders at Sheffield, England, and at Solingen, Germany, have been widely quoted in many of the textbooks and monographs upon this subject.

American Studies of the Ratio of Tuberculosis Deaths to Total Deaths in Various Industries

Data obtained in regard to the prevalence of occupational disease in different countries and at different periods of time must be interpreted with the greatest caution on account of the fact that industrial processes differ so widely and change so frequently. Recent statistics for the United States are necessary to throw a clear light on this problem, and such data, in order to be of conclusive value, should be available in the form of actual death rates, based on knowledge of the population exposed as well as on the number of deaths occurring, and properly corrected for the age distribution of the group involved.

Unfortunately, such complete statistical data as we desire are difficult to obtain in the existing state of American vital statistics, exact knowledge of the population at risk in a given occupation, classified by age, being obtainable only with great difficulty and by special and intensive research. For the most part, therefore, students of this subject have fallen back on an indirect index of the tuberculosis death rate, in the form of a ratio between deaths due to tuberculosis and those due to all causes. Data of this sort may, of course, be obtained with ease from the mortality records in any registration office or actuarial department. The hypothetical conclusion to which they lead may be illustrated as follows.

If the normal death rate from all causes at a given age period be 10 per thousand and 25 per cent. of the deaths are due to tuberculosis, the actual death rate will obviously be 2.5 per thousand for tuberculosis and 7.5 for all other causes. We find in certain specific occupations that the ratio of tuberculosis deaths to total deaths is respectively, let us say, 40 per cent., 50 per cent., and 60 per cent. of the deaths from all causes. We then assume — and here is the dangerous part of the argument — that the death rate from causes other than tuberculosis remains the same in all the groups under observation. If this be the case, the tuberculosis death rate in the three occupational groups will be $40 \times 7.5 \div 60$, $50 \times 7.5 \div 50$, and $60 \times 7.5 \div 40$, or 5.0, 7.5 and 11.2 per thousand respectively. The problem has nowhere been stated in quite this baldly quantitative form, but some such assumption must tacitly underlie the use of all such ratio statistics.

Three important studies of this kind have been made in the United States during the past decade. The first of these is con-

tained in bulletins of the U. S. Bureau of the Census giving the proportionate mortality by occupations of the population of the registration area for 1908 and 1909. The second is a bulletin on the industrial experience of the Metropolitan Life Insurance Company by L. I. Dublin, published as Bulletin 207 of the U. S. Bureau of Labor Statistics (1). The third, and most extensive collection of statistics of this type, is contained in a series of exhaustive monographs by F. L. Hoffman of the Prudential Insurance Company of America, the last and most important of which was published in 1918 as Bulletin 231 of the U. S. Bureau of Labor Statistics (2).

In the analysis of statistical data of this sort, it is clearly most important that the groups under consideration should be fairly comparable, so that the effect of industrial hazards will not be complicated by the influence of social and economic factors of a more general nature. In Mr. Hoffman's studies, for example, ratios presented for the various dusty trades are based on the industrial experience of the Prudential Insurance Company, but Mr. Hoffman uses as a norm for comparison the ratio for males in the registration area obtained from the data of the U. S. Census Bureau. On this basis almost all of the industries which he tabulates show a surprisingly high tuberculosis ratio, including many trade designations of workers, like "iron and steel workers," who can hardly be considered as generally exposed to a serious dust hazard. These results, as presented in the earlier publications of the Prudential Insurance Company, aroused the suspicion that the whole group covered by industrial policies might be a selected one, and in the most recent of Mr. Hoffman's reports (2) the solution to the problem is at last presented. In this report as a whole the old comparison is presented of tuberculosis ratios in each "dusty" trade among industrial policy-holders, with the ratio for all males in the registration area, but in one place (Table 11, p. 56) Mr. Hoffman gives the ratios for all occupied males in the Prudential experience. From this table it appears that the industrial policy-holder group does, as a matter of fact, exhibit a consistently higher ratio for all occupied males, irrespective of exposure to dust. Mr. Hoffman's abnormally high ratios are, therefore, due in large part to the general social and economic conditions of the wage earner's life.

This constant difference between the Prudential figures and the census data is clearly brought out in Table 1, which we have compiled from the tables in Mr. Hoffman's bulletin so as to include all the industries exposed to metallic or mineral dusts for which 500 or more deaths from all causes at all ages were available. It is evident that in almost every instance where the two series can be compared the Prudential ratios are from 25 to 50 per cent. higher than those for the registration area.

It seems evident that a comparison between the Prudential figures for a given dusty trade and the census figures for all occupied males is not a fair one, and that the conclusion indicated by such a comparison — namely, that such groups as the iron and steel workers experience an excessively high death rate from tuberculosis as a result of the dust hazard — is unwarranted. As a matter of fact, comparisons made in each case with the corresponding groups — census figures for a dusty trade with census figures for all occupied males, or Prudential figures for a dusty trade with Prudential figures for all occupied males — show that the tuberculosis ratio for the iron and steel workers is about normal, as might be expected for so diversified an occupational group.

Comparing specific trades in the Prudential experience with the Prudential group as a whole, and comparing specific trades in the registration area with the registration

group as a whole, both sets of data are highly illuminating and bring out very clearly the excessive tuberculosis ratios characteristic of certain occupations. The two sets of figures, allowing for the constantly higher ratios throughout the Prudential experience, check each other very closely, even in such details as the concentration of the highest ratios at ages under 35 among jewelers, and at ages over 35 among marble and stone cutters.

It is interesting to notice that Dr. Dublin's statistics for the industrial experience of the Metropolitan Life Insurance Company (1) correspond almost exactly with the Prudential figures. For all males in the Metropolitan experience, the ratio of tuberculosis deaths to total deaths was 33.8 per cent. at ages 15–24; 40.9 per cent. at ages 25–34; 32.9 per cent. at ages 35–44; 18.5 per cent. at ages 45–54; 8.6 per cent. at ages 55–64; 2.9 per cent. at ages 65 and over; and 20.5 per cent. for all ages over 15. These figures are almost identical with those presented in the upper line of the right hand half of Table 1, and it is evident that the ratios shown are characteristic of the industrial group as a whole.

TABLE 1.—RATIOS IN PER CENT. OF TUBERCULOSIS DEATHS TO TOTAL DEATHS IN OCCUPATIONS EXPOSED TO MINERAL AND METALLIC DUSTS *

Occupation	U. S. Registration Area Age Groups						Prudential Experience Age Groups					
	15–24	25–34	35–44	45–54	55–64	15 and over	15–24	25–34	35–44	45–54	55–64	15 and over
All occupied males	28.1	30.9	24.0	14.4	7.6	14.9	33.2	40.9	32.9	19.0	8.8	20.5
Brick, tile and terra cotta workers	..	..	..	..	..	..	22.9	35.3	19.8	18.6	10.7	15.6
Iron and steel workers	19.8	26.1	23.3	16.7	8.5	16.9	30.0	34.1	31.3	14.7	8.7	21.0
Plasterers	25.0	31.5	34.5	16.4	7.8	16.7	34.5	43.6	40.4	23.5	11.8	21.9
Molders	..	..	..	..	..	..	23.7	40.4	30.7	21.6	13.9	23.0
Paper hangers	..	..	..	..	..	..	35.1	44.0	42.5	15.7	11.5	29.1
Painters, glaziers and varnishers	30.8	36.9	29.2	17.4	9.0	18.7	..	..	..	..	..	..
Tinplate and tinware workers	39.4	36.7	34.8	13.7	6.6	18.7	..	..	..	..	..	..
Jewelers	50.0	39.7	23.4	14.1	8.5	17.8	50.9	58.3	45.3	21.2	11.1	29.3
Glassblowers	..	..	..	..	..	..	45.1	53.3	31.3	28.3	15.4	32.1
Other glassworkers	.	..	..	..	..	..	31.5	51.1	34.4	23.1	15.5	30.5
Glassworkers	47.2	42.6	33.1	19.7	7.9	30.0	..	..	..	..	..	..
Tool and instrument makers	..	..	..	..	..	..	37.5	52.7	36.9	33.7	10.4	31.9
Potters	..	..	..	..	..	..	31.2	49.6	39.8	30.2	21.1	32.2
Marble and stone cutters	26.2	43.5	44.1	41.6	23.3	30.7	38.3	51.1	44.4	39.0	26.7	33.6
Brassworkers	..	..	..	..	..	..	58.2	51.0	43.8	24.2	16.1	36.7
Compositors and type-setters	..	..	..	..	..	..	46.3	55.9	41.1	24.9	9.8	36.8
Pressmen	..	..	..	..	..	..	42.9	47.7	44.0	20.0	11.1	39.6
Printers, lithographers and pressmen	43.6	50.0	36.3	21.5	7.7	29.5	..	..	..	..	..	..
Polishers	..	..	..	..	..	..	43.4	56.1	44.0	24.9	14.3	36.8

* The figures given are taken from Bulletin No. 231, Bureau of Labor Statistics, U. S. Department of Labor.

Even when comparisons are made in the correct manner between a dusty trade and an average group of as nearly as possible the same general social and economic status, there must always be a large measure of doubt in regard to the significance of high tuberculosis ratios. Ratios, as distinct from rates, depend on two independent variables, and a high ratio of tuberculosis deaths to total deaths may be produced by a low mortality from other causes, as well as by a high mortality from tuber-

culosis. Thus, the tuberculosis ratio among female college professors and teachers, according to Dr. G. M. Kober (3), is high — a ratio which Dr. Kober attributes to the alleged fact that the teaching profession is "usually recruited from weak stock." L. M. Terman, in his book on *The Teacher's Health* (4), has also given currency to the view that teachers suffer to an exceptional degree from tuberculosis. The only careful statistical study of this subject with which we are familiar, Dr. L. I. Dublin's paper on *Physical Disability of New York City School Teachers* (5), shows that this conception is erroneous. The high ratio of tuberculosis deaths to total deaths among teachers is shown in this investigation to be due to the fact that the death rate from causes other than tuberculosis in this group is exceedingly small, the tuberculosis rate itself being less than two-thirds of the rate prevailing among females in the community at large, at the age of 15 and over.

Studies of the Actual Death Rates from Tuberculosis in Various Dusty Trades

It is by no means intended to discredit all use of mortality ratios, still less to throw doubt upon the real importance of the problem of industrial tuberculosis. We desire only to emphasize the possible fallacies in the use of ratios and the necessity for controlling deductions by the determination of actual death rates wherever possible.

In England numerous statistics are available which indicate that in many industrial employments, such as metal mining, marble and stone cutting, and grinding and polishing, high tuberculosis ratios are associated with high tuberculosis rates, exactly as might be expected from the theoretical considerations advanced above on page 335. In Table 2, for example, are presented the data for occupations exposed to metallic dusts, from the Sixty-Fifth Annual Report of the Registrar-General, rearranged and supplemented by ratio computations. They show that the excessive ratios of tuberculosis deaths to total deaths indicate an actual excess death rate from tuberculosis of one to two persons per thousand population; while at the later age periods, the death rate from causes other than tuberculosis among the workers exposed to the influence of metallic dusts is also well above the normal rate.

The earlier reports of the medical officer of health of the city of Sheffield contain particularly significant data in regard to the mortality in the intensively hazardous

TABLE 2. — MORTALITY FROM PULMONARY TUBERCULOSIS AND OTHER CAUSES IN OCCUPATIONS EXPOSED TO METALLIC DUST, COMPARED WITH THAT OF ALL OCCUPIED MALES, ENGLAND AND WALES, 1900–1902

Age Period	All Occupied Males				Occupations Exposed to Metallic Dusts			
	Deaths per 1000			Per Cent. Due to Tuberculosis	Deaths per 1000			Per Cent. Due to Tuberculosis
	Total	Tuberculosis	Other Causes		Total	Tuberculosis	Other Causes	
15–19	2.4	0.5	1.9	22	2.7	0.7	2.0	27
20–24	4.4	1.5	2.9	35	5.3	2.7	2.6	52
25–34	6.0	2.0	4.0	34	6.3	3.3	3.0	53
35–44	10.2	2.7	7.5	27	11.7	5.0	6.7	43
45–54	17.7	3.0	14.7	17	21.0	5.2	15.8	25
55–64	31.0	2.2	28.8	7	36.0	3.9	32.1	11
65 and over	88.4	1.1	87.3	1	95.5	1.5	94.0	2

processes of the cutlery industry. The report for 1910, for example, shows a mortality from pulmonary tuberculosis among grinders of 14.8 per thousand for the age of 18 and over, as compared with a rate of 2.7 for all occupied males of the age of 20 and over. The corresponding mortality from all other causes was 15.1 per thousand for grinders, and 13.7 for all occupied males; the ratio of tuberculosis deaths to total deaths was 49 per cent. for grinders and 16 per cent. for all occupied males.

Finally, we may cite one more example from the field of British industry, presented in the *Report of the Departmental Committee on the Dangers Attendant on the Use of Lead and the Danger or Injury to Health Arising from Dust and Other Causes in the Manufacture of Earthenware and China* (6). Dr. G. Reid of Stafford presents the following

TABLE 3. — MORTALITY FROM PLUMBISM AND RESPIRATORY DISEASES AMONG STAFFORDSHIRE POTTERS

Nature of Industrial Illness	Number of Workers Exposed to Risk	Average Annual Deaths Attributable to Employment	Annual Death Rate per 1000
Lead poisoning	5,299	4	0.8
Pulmonary tuberculosis and other respiratory diseases	21,000	148	7.0

computation (Table 3), which indicates that even in a trade like pottery making, which is generally considered as one of the industries most affected with plumbism, lead poisoning is far less important as a factor in the death rate than is industrial tuberculosis.

In the United States we have a few — but only a very few — data of this kind which show the actual death rates from tuberculosis in employments exposed to the hazards of industrial dusts. The only general collection of statistics of this sort with which we are familiar was presented in a special bulletin on *Tuberculosis in the United States*, prepared by the Bureau of the Census for the meeting of the International Congress of Tuberculosis, held in Washington in 1908. The highest and the lowest rates included in this tabulation are presented in Table 4, and they are suggestive and interesting, although the absence of an analysis by age periods detracts seriously from the value of the results, as does the fact that the occupational groups are large and often loosely defined. The high rates among cigarmakers and tobacco workers, compositors, printers and pressmen, servants, bookkeepers, clerks and copyists, and the low rates among bankers, brokers, and officials of companies are no doubt in large measure due to the age composition of the respective groups. In the high rate among servants the racial factor must certainly play an important part.

Important data in regard to the effect of mineral dusts upon the tuberculosis rate have recently been presented in the *Second Preliminary Report of the Committee on Mortality from Tuberculosis in Dusty Trades* (7), which deals primarily with conditions in the quarrying districts of Vermont. We have presented in Table 5 certain selected data from this report which indicate that in towns, and even in entire districts, where a considerable proportion of the population is exposed to mineral dust, the tuberculosis death rate for the entire administrative unit may be increased far above the normal value.

The most comprehensive study of this kind which has yet been completed was conducted by Dr. Herbert Drury in the Department of Public Health of the Yale School of Medicine, and dealt with the incidence of tuberculosis among the employees of an axe factory in the state of Connecticut. The factory in question employs about 800 men and is situated in a rural community where other industrial activities are largely agricultural. The vital statistics for the four adjacent towns

TABLE 4.—MORTALITY FROM TUBERCULOSIS IN CERTAIN OCCUPATIONS IN THE REGISTRATION STATES FOR THE AGE OF TEN YEARS AND OVER, 1900

Occupation	Deaths per 100,000	Occupation	Deaths per 100,000
Marble and stone cutters	540.5	*All occupied males*	*236.7*
Cigarmakers and tobacco workers	476.9	Steam railroad employees	129.8
Compositors, printers and pressmen	435.9	Clergymen	123.5
Servants	430.3	Miners and quarrymen	120.9
Bookkeepers, clerks and copyists	398.0	Farmers, planters and farm laborers	111.7
Laborers (not agricultural)	370.0	Lumbermen and raftsmen	107.1
All occupied males	*236.7*	Bankers, brokers and officials of companies	92.1

in which the operatives might reside have been analyzed in detail for a period of twenty years, and each death certificate for tuberculosis or other respiratory disease transcribed and investigated. The fact that the medical consultant of the axe factory and the superintendent had both been in the employ of the company during the two decades covered by the investigation made it possible to trace out practically every death certificate, and to determine the actual occupation of the deceased. The final analysis of the results yielded the astonishing figures presented in Table 6.

TABLE 5.—MORTALITY FROM TUBERCULOSIS OF THE LUNGS IN QUARRYING DISTRICTS OF VERMONT, 1906–1915

District	Tuberculosis Death Rate per 100,000 Population
State of Vermont	90.6
Granite cutting districts	143.0
Barre City (granite center)	233.2
Marble districts	97.1
Town of Dorset (marble center)	149.4
Slate districts	111.3
Town of Castleton (slate center)	176.0

Thus, we find the entire population of the mill district showing a tuberculosis rate of 200 as compared with 150 for the state as a whole. The mill population itself has a rate rising to 650, and the group of polishers and grinders the astounding rate of 1900. The other employees of the mill are not entirely comparable in age, race, and general social and economic status with the polishers and grinders, but it is evident that the high death rate among the polishers and grinders, who suffer from a tuberculosis death rate over ten times the normal rate, is primaraly due to the hazards of their occupation. Nor is tuberculosis the only form in which they pay a penalty for their hazardous employment. Dr. Drury reports that the mortality from pulmonary infections other than tuberculosis for the period 1900 to 1919 was 430 per 100,000 for the polishers and grinders, as compared with 170 for the other employees of the axe factory.

TABLE 6.—MORTALITY FROM TUBERCULOSIS OF THE LUNGS IN A CONNECTICUT AXE FACTORY, 1900–1919

	Death Rate per 100,000
State of Connecticut	150
State of Connecticut (male population)	170
Axe factory district (3 towns, entire population)	200
Employees of axe factory (all)	650
Employees of axe factory, polishers and grinders	1900
Employees of axe factory, others	160

Pathology of Industrial Tuberculosis

The effect of exposure to an intensive industrial dust hazard is well described in the following letter, written to the senior author several years ago by a physician in a small Massachusetts town where the principal industry was an axe factory much like the Connecticut factory where the statistical data cited above were obtained:

I have seen quite a number of cases of so-called grinder's consumption. The symptoms are excessive shortness of breath on slight exertion, dry cough and great prostration. The grinders are from the Po-

landers and Finns for the past dozen years. The disease takes hold of them more frequently, and is more rapidly fatal than among the grinders of former years and of other nationalities. When I came here forty years ago I found the victims among the Yankees who had ground some 20 years before. Those would grind 18 to 20 years before having to give it up. The French-Canadians were then grinding. They could work 12 to 16 years. They became frightened off and the Swedes took up the work. They would get the disease in 8 or 10 years. Now the Finns and Polanders are at it, and they last only 3 to 5 years, and the disease is more common among them.

The most exhaustive studies of industrial tuberculosis which have so far been conducted have dealt with the mining industry, particularly the studies presented in the report on *Siliceous Dust in Relation to Pulmonary Disease among Miners in the Joplin District, Missouri* (8), and in the invaluable reports of the South African Commission (9) (10) (11).* The South African reports have made it clear that the effect of fine rock dust is to produce "a chronic disease of the lungs, characterized by progressive fibroid changes in the lung tissue and pleura, and accompanied by chronic catarrhal processes in the air cells and respiratory passages. The disease is thus primarily a fibrosis of the lung." "In the later stages tuberculosis becomes commonly or invariably superimposed upon this condition and the type of the disease becomes that of a tuberculous infection in a fibroid lung."

It is, of course, possible to find the condition of pneumoconiosis without tuberculous infection. In the examination of 720 miners of Joplin (8), Dr. Lanza reports 5 per cent. as suffering from tuberculosis without evidence of injury from dust, 46 per cent. as suffering from pneumoconiosis without evidence of tuberculous invasion, and 15 per cent. as suffering from miners' phthisis, with pneumoconiosis on which the specific infection of tuberculosis had been superimposed. According to most authorities, pneumoconiosis by itself is rarely a fatal disease. and Dr. Lanza has described old miners at Joplin with lungs so damaged by fibrosis as to be unable to work, or to ascend a flight of stairs, but otherwise hale and hearty. As a rule, however, the tuberculous infection generally follows in time.

* The investigations now in progress under the auspices of the National Tuberculosis Association, in regard to industrial tuberculosis among quarrymen, should constitute a monumental contribution to the subject.

The Specific Influence of Particular Industrial Dusts in Relation to Tuberculosis

It is an interesting and significant fact that in every instance, so far as we are aware, in which a heavy incidence of tuberculosis has been clearly shown to result from exposure to industrial dust, the dust in question has been in part, at least, made up of crystalline rock. It is silicosis which lies at the base of miners' phthisis and which is probably the chief factor in the tuberculosis among axe grinders, although, in grinding and polishing, steel dust may, and probably does, play a part as well. No such striking statistical results as those cited for mining, quarrying and grinding, and pottery making have yet been presented for industries where crystalline rock particles are not involved.

In the case of certain industries we have ample evidence to show that the presence of dust in the lung tissues, and even the development of marked fibrosis, do not tend to predispose to tuberculous infection. Exposure to lime and cement dust, for example, as shown by Dr. George E. Tucker in California, and by recent work in Japan (12), appears not to be associated with high tuberculosis rates. The clearest and most striking case, however, is that of coal dust, which, if it has any effect, appears to exert a protective influence against the invasion of the tubercle bacillus. A clearly marked fibrosis (anthracosis) follows the inhalation of coal dust, and this condition appears to

favor a high mortality from acute respiratory disease; but the tuberculosis death rate among coal miners is uniformly and characteristically low. The figures presented in Table 7 from Hoffman's study (2) bring out the typical relation with great clearness.

The occupational statistics presented by the Registrar-General of Great Britain include a particularly striking comparison between coal miners and tin miners, the former exposed to coal dust, the latter to

TABLE 7. — MORTALITY IN COAL MINING DISTRICTS OF PENNSYLVANIA

District	Deaths per 100,000		
	Pulmonary Tuberculosis	Other Forms of Tuberculosis	Other Respiratory Diseases
Scranton	79.9	16.6	261.2
Wilkes-Barre	74.9	19.4	212.5
Remainder of state	110.5	16.4	184.2

hard crystalline dust. The comparative mortality figures for tuberculosis in 1900–1902 were 186 for all occupied males, 85 for coal miners and 838 for tin miners.

The reason for this extraordinary difference between the effects of different dusts is still largely a matter of speculation. It may be due to the physical character of the dust — the kinds that do not predispose to tuberculosis being generally softer and amorphous in structure, the kinds that do predispose being generally hard and crystalline or acicular — or there may be specific chemical influences at work, as seems particularly probable in the case of coal. Dr. Oskar Klotz in a valuable contribution on *Pulmonary Anthracosis — A Community Disease* (13) suggests that "carbon deposits by inducing fibrosis tend to encapsulate chronic tuberculous foci." We are left at a loss, however, to explain why the fibrosis clearly induced by siliceous dust does not exert a similar protective influence.

The most recent study of the difference between these specific effects of various dusts is a communication by Mavrogordato from Dr. Haldane's laboratory (14). Mavrogordato believes that coal and shale dusts on entering the lung tissue set up a vigorous catarrhal reaction which leads to their elimination, while siliceous dust is retained. He even suggests the possibility of securing protection against siliceous dust by mixing with it a certain amount of coal dust which will stimulate the elimination of both together. He admits, however, that an overdose of even coal dust may produce harmful effects.

It is perhaps safest to leave the question an open one for the present. It is clear that the dusts to which workers are exposed in metal mining, quarrying and grinding, strongly predispose to tuberculosis, and that the dusts produced in coal mining and cement working do not. The conclusive explanation of these facts remains for the investigator of the future.

With regard to a great intermediate group of other industries which have commonly been classed as dusty trades, we are inclined to await further and better statistical evidence before reaching a final conclusion as to the existence of what can fairly be called industrial tuberculosis. Mr. Hoffman believes, and most of the textbooks teach, that not only the iron and steel industry as a whole, the jewelry industry, and the printers' trades, but even many industries involving a relatively slight exposure to organic dust — such as boot and shoe making, the textile industry, and the like — are exposed to the hazard of industrial tuberculosis. For reasons cited in the previous section, we are inclined to regard these conclusions with a certain amount of scepticism. As indicated by the comparisons quoted in Table 1, it is evident that industrial workers, as represented by industrial policy-holders, show a ratio of tuberculosis deaths to total deaths dis-

tinctly higher than that characteristic of the general population. This higher ratio, even if it indicates a higher rate, may well be due to general social and economic conditions associated with the wage-earning life, and not directly to the conditions in the workshop itself. That it is the result of a dust hazard in such employments as the textile industry or the iron and steel industry, there is not the slightest reason to affirm.

We shall make progress most surely if we draw definite conclusions as to the existence of a real industrial tuberculosis only where intensive studies have shown a markedly excessive death *rate* from tuberculosis, as compared with population groups of similar social and economic status and racial composition. Evidence of this kind is available at hand chiefly, if not solely, for industries like metal mining, quarrying, pottery making and grinding, which involve exposure to large amounts of hard, crystalline inorganic dust.

(*To be continued*)

BIBLIOGRAPHY

1. Dublin, L. I.: Causes of Death by Occupation. U. S. Bur. Labor Statis., Bull. 207, March, 1917.
2. Hoffman, F. L.: Mortality from Respiratory Diseases in Dusty Trades. U. S. Bur. Labor Statis., Bull. 231, June, 1918.
3. Kober, G. M.: Occupation in Relation to Tuberculosis. U. S. Pub. Health Rep., 1920, **35**, 751.
4. Terman, L. M.: The Teacher's Health. Boston, Houghton Mifflin Company, 1913.
5. Dublin, L. I.: Physical Disability of New York City School Teachers. School and Society, 1916, **4**, 564.
6. Report of the Departmental Committee on the Dangers Attendant on the Use of Lead and the Danger or Injury to Health Arising from Dust and Other Causes in the Manufacture of Earthenware and China and in the Processes Incidental Thereto, Including the Making of Lithographic Transfers. Vol. 2, Appendices, Cd. 5278, London, 1910.
7. Second Preliminary Report of Committee on Mortality from Tuberculosis in Dusty Trades. New York, National Tuberculosis Association Sept., 1919.
8. Higgins, E., Lanza, A. J., Laney, F. B., and Rice, G. S.: Siliceous Dust in Relation to Pulmonary Disease among Miners in the Joplin District, Missouri. U. S. Bur. Mines, Bull. 132, 1917.
9. Report of the Commission on Miners' Phthisis and Pulmonary Tuberculosis, Cape Town, South Africa, 1912.
10. General Report of the Miners' Phthisis Prevention Committee of South Africa, Pretoria, 1916.
11. Final Report of the Miners' Phthisis Prevention Committee of South Africa, Pretoria, 1919.
12. Nagai, S.: Cement Inhalation and its Effect upon Tuberculous Lungs. Abstracted in Jour. Indust. Hyg. (Abstract Section), 1919–1920, **1**, 146.
13. Klotz, O.: Anthracosis — A Community Disease. Am. Jour. Pub. Health, 1914, **4**, 887.
14. Mavrogordato, A.: Experiments on the Effects of Dust Inhalations. Jour. Hyg., 1918, **17**, 439.

ESTIMATION OF TOXIC WATER SOLUBLE DUST WITH THE PALMER APPARATUS*

MIRIAM STEWART ISZARD, M.A.
Instructor, Laboratory of Hygiene, University of Pennsylvania

During the carrying out of tests for the determination of aniline vapors in the air, the question arose as to the possibility of finding aniline attached to the particles of dust formed in those branches of the industry which were dusty and in which aniline was one of the products or by-products. With this in view, tests were run to determine (*a*) the presence of aniline in the dust, (*b*) the total solid count, and (*c*) the number of dust particles.

These tests were conducted in front of the stills in the aniline plant while the iron oxide was being emptied out, the dust in this case being iron oxide, and in the indigo house in front of the vacuum driers when they were being emptied of phenylglycine and when the phenylglycine was being screened, the dust in this case being phenylglycine. In connection with both of these processes there is found a great amount of dust. Details of the processes are given in a previous article on the *Determination of Aniline Vapors in the Air* (1).

Method of Carrying Out Tests

In making the three determinations — namely, the aniline content of the dust, the total solids in the air, and the dust particle count and determination — the Palmer dust collecting apparatus was employed. For details as to the working of the apparatus, the reader is referred to Dr. Palmer's (2) article in the American Journal of Public Health. This apparatus was set up at the level of the worker's mouth and at the same distance from the machinery as that at which the worker stood. With the exception of the medium used for entraining the samples, all samples were collected in the same way. The determinations were made as follows:

A. Quantitative Determination of the Presence of Aniline in the Dust. — The medium used here was an approximately 10 per cent. solution of hydrochloric acid, a medium in which aniline is soluble and in which is formed an aniline hydrochloride. The samples were then titrated for aniline, using the sodium nitrite method of titrating as described under method II of my article on the *Determination of Aniline Vapors in the Air.*

B. Determination of Total Solids in a Definite Volume of the Air. — The medium here used was distilled water, though in this medium the phenylglycine was partially soluble. In determining the amount of total solids in the samples, they were first dried over a water bath in a porcelain dish, the weight of which had previously been determined, and then placed in an electric oven and dried to a constant weight. The difference between the weight of the dish and the final weight gave the weight of the solids in the sample.

C. Determination of the Total Dust Count. — The medium here used was liquid paraffin oil, since iron oxide and phenylglycine are not soluble in this oil. The determinations of the count were made by the method of Palmer, Coleman and Ward (3) as modified by Dr. Smyth (4).

Results of Tests

A. Table 1 summarizes briefly the results of the determinations of aniline attached to dust particles. As may be seen from this table, tests for aniline attached to

* Received for publication June 15, 1920.

TABLE 1. — QUANTITATIVE DETERMINATION OF ANILINE ATTACHED TO DUST

No. of Sample	Phase of Process	Duration of Process in Minutes	Collecting Apparatus	Medium Used	Amt. Aniline in 1 Cubic Meter	Amt. Sample Collected in Liters	Amt. of Aniline in Sample	Amt. Aniline Worker Inhales in Process
1	emptying still of iron oxide	20	Palmer dust collector	10% HCl	0.0636 gm.	566	0.036058 gm.	0.0108156 gm.
2	emptying still of iron oxide	20	Palmer dust collector	10% HCl	0.0780 gm.	566	0.044194 gm.	0.013254 gm.
3	emptying still of iron oxide	10	Palmer dust collector	10% HCl	0.0465 gm.	425	0.019768 gm.	0.059306 gm.

the dust were made in the aniline plant by the Palmer apparatus, the medium employed for getting the aniline in solution being a 10 per cent. solution of hydrochloric acid. The samples collected were titrated for aniline by means of the sodium nitrite test as described under method II of my previous paper (1).

B. The results of the determination of the total solids in the samples of air taken are briefly summarized in Table 2. These results show that the air, as regards total solids, had 1.4–2.7 gm. per 100 cubic feet, an amount greater than any recorded by Dr. Smyth and Dr. Miller in their article on *The Dust Hazard in Certain Industries* (5).

C. The tests upon the samples collected for the purpose of determining the number of dust particles per cubic feet are given in Table 3. These tests show a very high dust count. The difference between the counts of particles in the water medium and of particles in the liquid paraffin shows the value of the Palmer apparatus when a dust is being collected that is soluble in distilled water, for into this apparatus can be put different media, the medium in each case being chosen according to the character of the sample to be collected.

A microscopic study of the particles entrained in the medium showed that most of the particles in the samples collected while the iron oxide was being dumped from the driers, were dark brown with irregular jagged edges, which is characteristic of iron oxide, a metallic dust. The samples from the indigo plant showed fields of tiny, spherical, light brown, glistening particles, such as are characteristic of phenylglycine.

Significance of the Foregoing Results

1. As regards the presence of aniline attached to the particles of dust:

(*a*) The tests made at the stills showed a small amount of aniline attached to the

TABLE 2. — DETERMINATION OF TOTAL SOLIDS IN AIR SAMPLES

No. of Sample	Phase of Process	Apparatus Used	Length of Time Run	Amt. Collected	Total Solids in Sample	Total Solids in 1 Cu. Ft. Air	Total Solids in 100 Cu. Ft. Air
1	emptying phenylglycine from driers............	Palmer dust collector	10 min. at $2\frac{1}{2}$ cu. ft. per minute	25 cu. ft.	0.6751 gm.	0.0270 gm.	2.7 gm.
2	emptying phenylglycine from driers............	Palmer dust collector	15 min. at $2\frac{1}{2}$ cu. ft. per minute	30 cu. ft.	0.4200 gm.	0.0140 gm.	1.4 gm.

particles of iron oxide. Had similar tests been made for aniline attached to dust particles in the indigo house, we would doubtless have found a high aniline count, for the tests for free aniline in the air of the indigo plant showed a high aniline content (1).

The fact that aniline is present in such high quantity doubtless accounts for the illness of the workers connected with this phase of the process, since, as Lehmann (6) and Miller and Smyth (5) show, a worker may retain in his lungs one-third of the total solid material inhaled. The aniline present in the particles of dust retained finds its way into the worker's system and, unless it is eliminated, accumulates and produces a toxic effect on the blood. In considering the toxic effect of aniline, the entire amount retained in the body in both the respiratory and gastro-intestinal tracts must be taken into consideration.

(*b*) The efficiency of the Palmer dust collecting apparatus in entraining all the aniline attached to the particles of dust cannot be definitely stated. The apparatus is, however, efficient to the extent that it entrained a sufficient amount of aniline to give a positive aniline test in an atmosphere, which, when tested for free aniline, showed 0.04 gm. per cubic feet.

2. As regards total solids and the number of dust particles:

(*a*) The total solids determinations showed 1.4–2.7 gm. per 100 cubic feet, a weight greater than any recorded by Dr. Smyth and Dr. Miller in their article on *The Dust Hazard in Certain Industries* (5).

(*b*) As far as the number of dust particles present is concerned, the results showed that about 1,000,000 particles were present in 1 cubic foot in the indigo plant and 5,000,000 particles were present in 1 cubic foot in the still room of the aniline plant while the processes were in operation. The high count of dust particles plus the presence of aniline attached to many of the particles indicates clearly the desirability that workers should be protected from inhaling the dust.

TABLE 3.—NUMBER OF DUST PARTICLES IN A DEFINITE VOLUME OF AIR

No. of Sample	Phase of Process	Apparatus Used	Length of Time Run	No. Cubic Feet Air Drawn Through	No. Particles per Cubic Feet	Medium Used	Particles (Average of 10 Fields): Relative Distribution According to Size	
							0.001–0.01 mm.	0.01–0.04 mm.
1	emptying still of iron oxide	Palmer dust collector	5 min. at 3 cu. ft. per minute	15	5,000,000	water	176	15
2	emptying still of iron oxide	Palmer dust collector	5 min. at 3 cu. ft. per minute	15	4,500,000	water	150	10
3	emptying drier of phenylglycine	Palmer dust collector	10 min. at 2½ cu. ft. per minute	25	1,184,000	liquid paraffin	71	3
3	emptying drier of phenylglycine	Palmer dust collector	10 min. at 2½ cu. ft. per minute	25	656,000	water	30	0
4	emptying drier of phenylglycine	Palmer dust collector	15 min. at 2½ cu. ft. per minute	37.5	1,900,000	liquid paraffin	140	3
4	emptying drier of phenylglycine	Palmer dust collector	15 min. at 2½ cu. ft. per minute	37.5	300,000	water	20	0

Conclusions

The results of tests made for determining quantitatively the presence of aniline attached to dust particles in the air lead to the following conclusions:

1. The Palmer dust collecting apparatus can be used for determining the presence of aniline attached to dust particles in the air by using a medium in which aniline is soluble.

2. The Palmer dust collecting apparatus can be used for determining the count in the air of dust particles which are soluble in distilled water by substituting a medium in which they are not soluble, as for example, paraffin oil.

3. The Palmer dust collecting apparatus can be used for determining total solids in the air.

4. In collecting a sample of aniline from the air, a sufficient amount should be collected to enable the observer to make at least two titrations on each sample. The longer the apparatus is run the more accurate will be the results.

BIBLIOGRAPHY

1. Iszard, M. S.: Determination of Aniline Vapors in the Air. Jour. Indust. Hyg., 1920–1921, **2**, 259.
2. Palmer, G. T.: A New Sampling Apparatus for the Determination of Aërial Dust. Am. Jour. Pub. Health, 1916, **6**, 54.
3. Palmer, G. T., Coleman, L. V., and Ward, H. C.: A Study of Methods for Determining Air Dustiness. Am. Jour. Pub. Health, 1916, **6**, 1049.
4. Smyth, H. F.: Suggested Modifications of the Standard Method for the Study of the Dust Content of Air. Am. Jour. Pub. Health, 1918, **8**, 769.
5. Miller, T. G., and Smyth, H. F.: The Dust Hazard in Certain Industries. Jour. Am. Med. Assn., 1918, **70**, 599.
6. Lehmann, K. B., Saito, Y., and Gfrörer, W.: Ueber die Quantitative Absorption von Staub aus der Luft durch den Menschen. Arch. f. Hyg., 1911–1912, **75**, 152.

STUDIES IN INDUSTRIAL PHYSIOLOGY: FATIGUE IN RELATION TO WORKING CAPACITY. I. COMPARISON OF AN EIGHT-HOUR PLANT AND A TEN-HOUR PLANT

A REPLY

The writers of Public Health Service Bulletin No. 106 are indebted to Dr. Drinker for an opportunity. His criticism in the October number of the Journal of Industrial Hygiene calls their attention to the danger that the purpose and nature of their report may be misapprehended. They take, therefore, this occasion to state what in their opinion is the precise value of such a body of facts as is contained in the report under discussion, and what their purpose was in following the manner of presentation adopted.

The study of the human factor in industry has, as is well known, lagged far behind the study of its mechanical agents, of plant, equipment, machinery, etc. Only lately, and especially under pressure of war, has human working capacity begun to claim its arrears of scientific inquiry and investigation. The admirable work of the British Health of Munition Workers' Committee broke ground in a number of directions for such inquiry and study. They performed a signal service in focussing attention upon some of the pressing and unsolved problems of labor — among others on the length of working hours — and they presented valuable evidence on the output of workers operating under different factory schedules. In emphasizing the need of extending such inquiries and increasing their precision, of multiplying exact investigation, lay one of the most valuable contributions of their reports.

The body of fact which was at the disposal of the writers of the American report was the result of an able, exact, and painstaking study. It had been dominated by the spirit and so far as possible pursued by the methods of scientific research. Observations in the field had been conducted with minutely careful accuracy. Every precaution had been taken to reduce the possibility of error, alike of observation and record. Methodologically it represented an appreciable advance in technique over the British reports. It constituted in its strictly limited field the most intensive study of output and accidents yet recorded, so far as known to the writers, for any two factories.

The findings of the investigation at these two plants might indeed have been presented separately without comment and without indication of contrast. But from the mass of data furnished by a scientifically disinterested study, one contrast, when the facts were analysed and sifted, persistently emerged, inevitably challenging attention. The factory running on the eight-hour schedule showed a remarkably steady maintenance of output; the factory running on the ten-hour schedule showed as marked a decline. The eight-hour workers, again, all showed a tendency to work to capacity, the ten-hour workers in many cases deliberately to fix or limit their output. The eight-hour plant records showed almost no loss of time; at the ten-hour plant lost time in beginning and ending work was the rule. At the eight-hour plant accidents varied very nearly with speed of production; at the ten-hour plant a heavier increase of risk seemed to accompany the failure of working capacity. This contrast seemed to the writers highly significant. It indicated to their minds, where other explanations considered failed to cover the case, a certain conclusion as to the efficiency of one schedule over another. Was this contrast to be obscured without hypothesis adopted or conclusion drawn? They accepted frankly the indication of the facts, embodying in each chapter the contrast between the two plants, letting table and chart so far as possible speak for themselves, but giving the gist of the difference by a condensed statement of findings placed at the head of each chapter. These findings, for the convenience of the reader, they reprinted in substance on a single page at the end of the introduction under the inclusive heading, *Relative Efficiency of the Eight-Hour and the Ten-Hour Systems as in Operation at the Two Plants Studied*, and with this reservation they stated the eight-hour system to be the more efficient on the showing of the facts.

While the writers stated conclusions only on the data presented by the study of the two plants, in the text of the report they called attention to the "universal tendency" to which these limited conclusions pointed: that under a shorter schedule human beings work nearer to capacity, and that greater concentration of effort is the unconscious response to shorter

hours. It is needless to say that this relation of higher working capacity to shorter hours is no new discovery. From the classic industrial experiments such as Abbé's down to the studies of the Health of Munition Workers' Committee, it has been an hypothesis constantly and increasingly verified. Dr. Drinker himself accepts it as a commonplace in his reference to "the unconscious speeding up which follows a reduction in hours of work." In referring the specific conclusions on lost time and stereotyping to a general truth, the writers of the bulletin might have called to witness an important body of older industrial experience as well as the pronouncements of the British committee.

Any study of output, however limited, to be fruitful cannot be unrelated to the actual world of industry of which it is a part, and in which the length of working hours has been a subject of speculation for almost a century. Science itself is based on postulates, and isolated unrelated scientific data, fitting into no hypothesis, would be barren indeed, even in laboratory experiment. How much more so in a study of industrial output the object of which is to illuminate larger industrial and social problems, and not only to stimulate research but to lead to experimental action. When the reviewer questions the inferences drawn, is "sceptical" that the difference in working hours accounts for the difference in working capacity between the two factories, he calls salutary attention to the complicated nature of the problem. Clearly the relation of working capacity to length of hours, influenced as it is by a multitude of related factors, cannot be definitely proved by the study of two comparable plants or, indeed, of twenty comparable plants. It could not be proved beyond question even by the study of one single plant running under different schedules of hours. For even within the walls of a single factory at different times variants could not be excluded, as in a chemical analysis, and the conditions of work kept exactly the same. Differences of stock, differences of experience, differences of good or ill-will on the part of the workers, and many other differences might all affect the outcome of the experiment. For definitive proof of hours as the cause of variation, investigation must be multiplied a thousandfold. Approximation to such proof would lie in a volume of investigation, a persistent coincidence among a multitude of variants. Such a volume or such an overwhelming coincidence was obviously not presented in a report the very name of which (*Comparison of an Eight-Hour Plant and a Ten-Hour Plant*) was intended to make clear on the title page the exact scope of the field from which the facts were drawn.

To the reviewer other causes than length of hours appear more likely to be accountable for the difference of working capacity at the two plants — such causes as differences in management and in the constitution of the labor force. That these possible factors were not ignored by the writers, a discussion of these points in the introductory chapter makes clear. They were considered and estimated as being contributory but not the primary cause of the difference between the two plants. While fully granting that we are here in the field of reasoned judgment rather than of complete scientific proof the writers, among several alternatives, held to be primary the one to which in their opinion the weight of evidence inclined.

That the view taken by the Bulletin is the correct one and that the hour schedules are the main differentiating element in the efficiency of the two plants is, in the opinion of the writers, borne out by analysis of the factors involved. Two variants were suggested by Dr. Drinker, each of which he regards as more likely to influence working capacity than length of hours: quality of management and quality of labor. Two indices of working capacity were used in the Bulletin: output and accidents. Taking as possible causes for the contrast in working capacity at the two plants hours, management and quality of labor, it was possible, when considering accidents in the two plants, largely to eliminate management as a variant, and when considering their output largely to eliminate the quality of labor force as a variant. In the case of both output and accidents, the difference in hours persisted as a steady factor in the contrast between the two plants.

Thus, in respect to output, the quality of labor at the two plants may be considered practically on a par. While the eight-hour plant as a whole possesses a more stable body of workers as compared with a more shifting group at the ten-hour plant, it is clear from the report that only piece-rate workers were studied at the latter plant. Since piece rates are paid only to employees who are no longer learners, this is proof to a careful reader that the records of the investigation do not cover work done by the transient or floating type of worker. That such workers are excluded is implicit in the

facts. We might, indeed, have stated further that many of the workers studied at this plant had been at their respective jobs for ten or even fifteen years, and it is quite possible that the average experience of the ten-hour workers was longer than the average experience of the eight-hour workers. In management, however, admitting for the sake of argument that the eight-hour plant is more efficient, this more efficient management may indeed hold the eight-hour workers more strictly to their tasks. Yet, on the other hand, at the ten-hour plant where piece wages are paid, in contrast to the time wages paid at the eight-hour plant, self-interest, even under less efficient management, should tend to keep the workers up to capacity. It is in the face of their own self-interest that these workers work below capacity. The ten-hour plant ranks too high, moreover, in general managerial efficiency for us to refer the whole contrast to slacker management.

In respect to accidents, the quality of the management at the two plants may be considered practically identical. Both factories rank high in the safety-first movement and take every precaution to lower accidents to a minimum. The heavier increase of risk at the ten-hour plant might naturally, then, at first glance be associated with the larger body of inexperience, since the accident records studied covered the entire labor force. The statement in the text, however (p. 130), that the inexperience raises the level but does not change the general character of the accident curve, rests on good evidence, corroborated by Bulletin 234 of the United States Bureau of Labor Statistics (Table 63). The presence of inexperience is not, then, sufficient to account for the greater rise of accident risk at the ten-hour plant.

Thus, when we eliminate the variant of labor, we find differing management insufficient to explain our contrast in working capacity as tested by output. When we eliminate the variant of management, we find a differing labor force insufficient to explain our contrast in working capacity as tested by accidents. For the major factor of the contrast we are brought back to the differentiating element steadily present in our study, the length of hours.

Doubtless besides the three causes under discussion other causal elements were present in the problem, elements which may be of greater or less contributory influence. To make a full appraisal of all these — wages, product, climate, sex, living conditions, etc. — should be a matter of years of research. All these elements must be studied before industry can be conducted on a right physiological basis. Meantime Bulletin No. 106, as stated in the introduction, was not intended to be "a study *in vacuo*," and "not an academic inquiry." In the field of human productivity final solutions lie far off, but immediate and vital questions may not go unanswered. No more than medical science in the laboratory, can industrial science in the factory or, indeed, any applied science wait always upon ultimate proof. Even the great hypotheses of pure science have not waited for statement till the evidence should be all in; the evidence is even now only in process of accumulation. In default of final statements, experiment and practical action must perforce follow the strong indication of probability. The writers of the Bulletin, on the evidence in hand, stated conclusions as indicated to their minds by the facts, inviting further and more inclusive research to confirm or refute them. The expectation of such future research, "a new era of intensive study," following the more impressionistic era of the past is specifically emphasized in the Bulletin. "If such a study . . . is to be fruitful," said the writers, "it must be pursued as a science; and to such a science the results of the present investigation are offered as a definite if limited contribution."

Among additional points to which Dr. Drinker calls attention is the relation of output to fatigue. The writers of the Bulletin are entirely in accord with him in believing that output data do not justify conclusions relative to fatigue in the narrowly physiological sense. On page 29 of the introductory chapter they sought to make this clear by stating specifically that it is not the crude physiological entity of fatigue — still undefined, as Dr. Drinker says — which explains the fall of the output curves. "It is well recognized that the fall is not due to such fatigue alone. In the great complexity of man's psycho-physical constitution, reacting to the most diverse stimuli, other remoter manifestations of fatigue, psychological and nervous, are operative in contributing to the fall of production." The output data, then, while they cannot be held to measure fatigue in the narrow sense, do indeed justify conclusions relative to fatigue in this larger sense which includes not only the manifestations of physiological fatigue but also remoter psychological reactions. Of these even self-limitation of output may be considered one. For self-limitation, which the

reviewer admits to be "unquestionably protective," where it is not a matter of economic self-protection, can itself be explained as in large part a reaction of a past experience of fatigue.

A word remains to be said about the necessarily non-inclusive character of a bulletin which was designed to be the first of several reports on this investigation. It was obviously not within the province of writers reporting on a special section of an investigation, extended in time and covering a wide field, to deal with all its aspects. That they were well aware of the desirability, emphasized by Dr. Drinker, of including the findings of a medical and sociological study in the present report is clear from pages 23 and 24 of the Bulletin. Here, under *Limitations of the Present Study*, they are at pains to note as a serious incompleteness in the material at hand the lack of precisely such a study as the reviewer indicates, and to point out the need of a "companion investigation" to supplement it, "an investigation of individuals" showing the physiological differences in their reaction to work, "a study initiated today by industrial medicine and nursing and capable of far-reaching development."

Finally, Dr. Drinker's rather sweeping pronouncement as to British and American methods calls for some comment. The American investigators played, he considers, an almost imitative rôle. "It is unfortunate," he writes, "that the Public Health Service investigators worked practically entirely with the methods of the English Health of Munition Workers' Committee, and that the United States is thus unable to contribute to the subject a degree of freshness and originality which its importance demands." We are dealing here with matters of fact not opinion, and we may in reply point out certain facts which may have escaped the attention of the reviewer and which should be set straight.

1. It is obvious that the investigators for the British Health of Munition Workers' Committee conducted practically no actual continuous observation of output in the factory itself. To obtain weekly output the use of factory books is entirely legitimate where the investigator is satisfied that the records are properly kept, but that does not alter the fact that the American data as to hourly output offer a contrast rather than an imitation.

2. The investigators for the British committee give practically no hour-by-hour curves. The only exception occurs in their last memorandum where a few isolated operations are collected for comparisons with an accident curve.

3. The investigators for the British committee made no attempt to distinguish the different types of hour-by-hour curves on different types of work either in relation to output or accidents.

4. The American investigators broke entirely new ground:

a. In using the relative deviation from the best hour as a measure of efficiency in both output and accident curves.

b. In using the accident-output ratio as a measure of accident risk and computing the accident-output ratio as an hourly curve. The new developments in technique are described in the Bulletin.

c. In segregating output curves on operations where output was restricted.

d. In attempting to represent the hourly output curve of a factory as a whole by combining the curves from the different types of work as found there.

e. In definitely trying out the effect on daily and hour-by-hour output of introducing recess periods.

f. In attempting to correlate turnover, absenteeism, and the physiological condition of the workers with certain physical conditions in the different departments of each factory.

These facts must have escaped the reviewer's notice. They show that no basis exists for the statement that rhythm in industry is "the single novel feature of the entire work of the Public Health Service investigation." Without belittling the magnificent work of the British Health of Munition Workers' Committee, it is clear that the American investigators have made a distinct contribution in the development of methods to be pursued hereafter in important and necessarily more extensive studies.

To sum up, then, the value of the report may be said to lie in (1) the volume of authoritative fact presented, (2) the new or revised technique of the investigation, (3) the precision of presentation aimed at, and (4) the stimulus which it in turn, following the British reports, may exert in leading to further exact research into the central and most neglected problem of production, the human factor. — *Josephine Goldmark* and *Mary D. Hopkins.*

BOOK REVIEWS

Fatigue Study. The Elimination of Humanity's Greatest Unnecessary Waste a First Step in Motion Study. By Frank B. Gilbreth, Member of American Society of Mechanical Engineers; Member Franklin Institute; Past Vice-President Society for the Promotion of Engineering Education; Honorary Member Society for the Promotion of Occupational Therapy: and Lillian M. Gilbreth, Ph.D. Second edition, revised. Cloth. Pp. 175 with illustrations and index. New York: The Macmillan Company, 1919.

The second edition of this exposition of the Gilbreth methods for attack upon the problems of working efficiency is practically a reprint of the first, the addition of several new illustrations and a final short chapter summarizing the general progress in fatigue study during the past two years representing the only real alterations. It is, however, particularly valuable to have systematic attention to the fatigue problem from an engineer, since the present attack in this country is largely through the medium of physiologists. In insistence upon the value of rest and economy of effort in work, the Gilbreths are more vigorous than those who have come into such investigation with the purely physiological or psychological point of view.

Manufacturers interested in various types of work chairs and tables designed to reduce fatigue and increase efficiency will find valuable and suggestive illustrations in the book. Indeed, though small, this publication represents the only effort at collection of such devices available in the English language. — *Cecil K. Drinker.*

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II FEBRUARY, 1921 NUMBER 10

ORIGIN AND DEVELOPMENT OF THE FACTORY MEDICAL SERVICE IN BELGIUM*

D. GLIBERT, M.D.
Inspector-General and Chief of the Factory Medical Service, Belgium

WITH AN ADDENDUM BY

W. F. DEARDEN, M.R.C.S., D.P.H.
Certifying Factory Surgeon, Manchester

SINCE the creation of the Ministry of Industry and Labor in 1895, the Factory Department has included among its personnel four doctors of medicine. At first there was no differentiation between the duties assigned to the doctors and those exercised by other inspectors. It was their duty to administer regulations of a social and economic character (law governing employment of women and children, workshop regulations, payment of wages, prevention of accidents, etc.) just as, on the other hand, their engineer colleagues attended to the supervision of the hygienic and general health measures prescribed by our factory code. Apart from these appointments, a medical practitioner was, in November, 1895, attached to the central administrative department with a special mission to carry out research work in the field of industrial hygiene and to study any matters bearing on health conditions in factories and workshops.

It soon became evident that the inspection exercised by doctors should be in the direction dictated by their special knowledge and scientific training in questions of physiology and pathology. It was recognised that if the intervention of an engineering expert is indicated in matters of constructional sanitation, safety, prevention of accidents, etc., the collaboration of the doctor is an evident necessity for solving questions of health, and that the study of morbid influences of occupation on the human organism is within his exclusive domain. Daily observation in the very heart of industry itself, and an intimate knowledge of the individual worker render the medical man indispensable as a collaborator with the engineer. The two professions are the complements of each other, and every day experience makes it plain that only good can arise from the respective specialisations assigned to each. It was for this reason that, by a decree of Jan. 31, 1898, the scope of medical inspectors in the provincial service was limited to the administration of regulations concerning health conditions of workplaces and to special inquiries relating to industrial hygiene generally.

The medical inspectors exercised their

* Received for publication August 23, 1920.

functions, under the control of the central administration, over those industries of the country placed under the supervision of the Factory Department. The regions assigned respectively to these doctors were: (1) the districts of Brussels and Louvain, the provinces of Antwerp and Limburg; (2) the two Flanders; (3) the provinces of Liége and Luxemburg and the districts of Namur and Dinant; (4) the province of Hainault and the districts of Nivelle and Philipville. In accordance with this distribution, the medical inspectors made their inquiries into the health of the workpeople in the various trades concerned.

The results of these special inquiries created an evident appreciation of the useful purpose to be served by freeing these medical inspectors from a still greater portion of their actual supervisory functions, in order to enable them specially to devote their energies to research and study in their own particular line. The decree of June 17, 1902,* amending that of Jan. 31, 1898, so delimitated the mission of the medical inspectors. These officers were directed to investigate the general and particular causes of unhealthiness in establishments placed under the supervision of the Factory Department. In this connection, it was incumbent upon them to draw up, in accordance with a model form provided by the central administration, detailed observation notes on the results of their investigations. In addition they were still charged to secure the carrying out of certain requirements of special decrees regulating employment in connection with the manufacture of matches, the manufacture of white lead and other lead compounds, the use of white lead for painting in buildings, the vaccination of workers among rags, the necessary measures to secure first aid in case of factory accidents, and the employment of women after childbirth. Reports of these visits were drawn up and forwarded periodically to the central administration.

The organisation of the medical service was further completed by the addition of a certain number of associated medical practitioners who were charged with the carrying out of medical requirements and rules, prescribed by regulations governing specified factories where work in particularly unhealthy industries is permitted (manufacture of matches, manufacture of white lead, paint work in buildings). These practitioners were also under obligation to notify the department of any features of interest in industrial hygiene to which their attention might be drawn. The number of associated practitioners (whose appointments had to be renewed every three years) was, in 1913, about 150. They were distributed over the principal localities of the kingdom.

Finally, about 1905, a small research laboratory was attached to the central administration. It is here that the current analyses of water, dust, air, etc., are conducted, as well as researches and experiments in industrial physiology and pathology.

Independently of the work of concentrating the information gathered from the provincial medical inspectors, the central administration was directed to investigate from a health point of view the applications submitted to the King for authority to carry on industries which were scheduled as dangerous, unhealthy or unwholesome. It had further the duty of assisting in the co-ordination and elaboration of special rules authorising preventive measures in certain industries and in particularly noxious trades. It was in this connection, notably, that the decrees regulating the utilisation of white lead have been modified under the law of Aug. 20, 1909, and that the royal decrees of Aug. 20, 1908, Aug. 10, 1912, and of Jan. 15, 1914, have prescribed the disinfection of horsehair in brush mak-

* This decree has been completed later by that of Aug. 1, 1906, so far as concerns the supervision of working at white-lead painting.

ing, have regulated in a special manner work in the fur-cutting industry, and have at last settled the conditions of work in compressed air caissons. A considerable proportion of these regulations were, as a matter of fact, placed under the supervision of the medical inspectors, although no fresh decision had increased their administrative functions fixed by the decrees of June 17, 1902, and Aug. 1, 1905.

A fresh rearrangement of the degree of supervision to be assigned to medical inspectors was under consideration in 1914, when the war caused a break in the activities of the service and completely upset the whole administration. Since the armistice the scattered elements of the various pre-war projects have been carefully reassembled, and the time has appeared to be opportune, in the course of a general reorganisation of the services, to make a decisive step in the domain of industrial medicine by placing upon its feet an organisation better adapted to the needs of the day. The experience of the war demonstrated, notably in England and in France, that the bringing into being of new methods of working, the intensification of production necessitated by the extent of hostilities, and the steadily increasing participation of the female sex in industry, demanded more and more the close and daily collaboration of the doctor in the regulation of conditions of labor. Our country, which was the first to introduce the medical man as such within the circle of factory inspection, and which had successively rearranged his duties to conform with the needs of the moment and the incessant progress of hygiene in industry, considered it a duty to establish on a new basis the organisation of medical inspection and to extend the intervention of the practitioner to all the domains affecting the social life of the worker.

Up to this period the regulations in force made no provision for the intervention of a medical official in at least half of the great industries. All the establishments, for instance, subject to the supervision of the Administration of Mines — that is to say, coal and metal mines — were inaccessible to him. Again, his intervention in provident matters and insurance was nil. It was now perfectly clear that before the function of the doctor could be further extended the Factory Medical Service must be self-contained and independent of the Factory Inspection Department proper. Actuated by these convictions, the Minister of Industry, Labor and Reconstruction recommended for royal signature the decree of June 25, 1919. This decree, in consecrating the institution of a Factory Medical Service attached to the Ministry of Industry, Labor and Reconstruction, defined its mission in the following terms:

1. To organise the protection of child-bearing or nursing women engaged in industrial occupations.

2. To protect the health of apprentices, and to assist in directing them into the occupation for which they are best fitted (orientation).

3. To study industrial physiology and pathology in all its phases.

4. To bring to bear the special knowledge of its agents on all projects of social providence.

5. To spread among the industrial population a knowledge of the most useful rules of prevention and to bring about the institution of rational methods of promoting health.

6. To supervise the execution of medical regulations.

The actual organisation consists of:

1. Officials attached to the central administration.

2. Officials resident in the provinces whose jurisdiction and place of abode are fixed by the decrees of the Ministry of Industry, Labor, and Reconstruction.

The officials attached to the service must possess either a diploma of doctor of medicine or a diploma of doctor of science.

The program and the responsibilities of the new service being so clearly established, it became essential, in practice, to delimitate in a precise manner the relationship of the organisation with those already existing services which require its active collaboration. At the same time the modifications introduced into the operations of the Factory Department rendered still more necessary such a delimitation. A royal decree, dated Sept. 15, 1919, has regulated the relationship of the medical service with the Factory Department. This decree confers upon the officials of the medical service the status of factory inspectors; it determines their prerogatives in the matter of classing and scheduling of dangerous trades and of dealing with requisitions for authorisation of such classified establishments; it also enumerates the regulations which they are directed to administer. These arrangements cover the preventive and sanitary measures forecasted by the law regulating the employment of women and children, as well as the decree relating to health and safety. Among these decrees may be cited those which provide for first aid to the victims of factory accidents; the vaccination of employees in rag depots; the occupations of loading, discharging, repairing and maintaining ships and boats; the disinfection of hair in brush manufacture; regulation of places temporarily used as lodgings for people employed in brickfields and workyards; the sale, transport and use of white lead in powder, lump, and paste; the utilisation of white lead for painting of buildings; the manufacture of white lead and other compounds of lead; the occupation of fur-cutting; work in caissons under compressed air.

A ministerial decree, dated Oct. 25, 1919, regulates the methods by which this supervision is to be exercised and the administrative interconnections between the Factory Department, factory inspectors, and the medical service. Following out the same ideal, the medical service is to investigate the question of supervising the sanitary measures which up to the present time have been administered by the Department of Mines, and which will now be delegated to medical inspectors. A decree will be promulgated immediately to establish the relationship between the two services.

A program so wide and with attributes so extended inevitably necessitated the enlarging of the list of administrative personnel. As a consequence, to secure the carrying out of the royal decrees of June 30, Sept. 15, and Sept. 30, 1919, the actual list has been so enlarged, and now includes myself, as Chief of the Service, with two principal inspectors, and a chemist attached to the central administration, and one chief inspector with six inspectors attached to the provincial service.

Addendum

The above article is succinct, clear, and unembellished with redundant phraseology, but the information, categorical though it may be, is there and certainly discloses a really wonderful history.

To what extent the results described are due to the untiring energy and persistence of Dr. Glibert, who is himself the medical man referred to as appointed in 1895 to study the medical aspect of industrial conditions, may be conjectured by those who have the honor of his personal acquaintance. The fact remains that, in the comparatively short space of twenty-five years, what might justly be termed an ideal system has been brought into being under his fostering care and management; that he should be placed at the head of the new department is but a fitting compliment to his exceptional abilities both as an organiser and as a man of high scientific attainments.

That Dr. Glibert has been well supported in his efforts there is no doubt. The Belgian race is exceedingly practical and has not been slow to recognise that one of the most important foundations of commercial prosperity is the elimination of waste. What may be termed the artificial production of disability in the worker, through employment in unregulated unhealthy industries or under unhygienic conditions, has been fully recognised as a telling handicap in the economy of production, and this active little nation has certainly not allowed the grass to grow under its feet in tackling this combined medical and economic problem. Of course there is still much to be done before the system can be regarded as complete, but the Belgians have got the machinery and the proper spirit and it may be taken that what has to be done will be done.

Dr. Glibert has quite properly restricted himself to a description of what has already been accomplished but, as a corollary to his article, some reference to the practically matured projects of the Belgian government, in the matter of medical examination and supervision of young people, from 14 to 18 years of age, engaged in industrial pursuits, should be of interest to the readers of this Journal.

Dr. Glibert mentions that among the primary duties attached to the new department, on its foundation, is the protection of the health of apprentices and the rendering of assistance in directing them into occupations for which they are best fitted. One of the first tasks undertaken by the Factory Medical Service was to study this question with a view to adopting a practical scheme of medical supervision of these adolescents. A copy of the draft royal decree, embodying the results of their efforts, with an introductory note and a report on these issued by the Conseil Supérieur d'Hygiène, are published in the first number of the *Bulletin du Service Médical du Travail*, which also contains Dr. Glibert's article. The suggested decree provides for medical examination during the first month of employment, a general re-examination every year and supplementary examinations at the discretion of the district medical inspector. The obligations of the employer are, generally, to render every assistance and, specially, to keep a record of all adolescents in his employ, to be produced to the medical inspector when required; to advise the district inspector, within twelve days of engagement, of the employment of any person under 18 years of age; to advise the medical inspector, during his visits, of any cases of habitual ill health or loss of time through sickness; to provide a suitable private room for medical examinations; to pay the examinee for time lost through the examination; to take note of recommendations for safeguarding the physical development of doubtful cases.

The examinations are to be made by the agents of the Factory Medical Service, who are to be paid by the government, but may be made by medical men engaged by the employer, at his own expense. Such medical men must be approved by the department, must conduct the examinations in a prescribed form, and must report the results of each visit to the district medical inspector. The examinations may also be made by the employee's own doctor, who must give a certificate in a prescribed form at such times as may be required by the medical inspector. No adolescent who objects to submitting to the medical examination may be employed.

The first paragraph of the introduction makes a definite pronouncement that the government does not propose to cramp or limit the recruiting of industrial workers, but insists that the regulations should, on the contrary, have the effect of improving considerably the economic returns of labor. They do not aim at debarring any appreciable proportion of the industrial population from the workshop or from work, but

rather to supersede the old-fashioned methods of giving assistance by substituting a system of occupational adaptation which will find room for the feeble and undersized. The argument proceeds as follows:

It is extremely rare to find adolescents of working age incapable of remunerative employment. If we except the functionally impotent and the sick, any adolescent can, without compromising his health, contribute sufficiently to production to earn at least a reasonable proportion of his living. It is a question of observation and of choice of occupational education. Following out this view, the government, in taking account of up-to-date requirements, has thrown over the old fashioned "certificate of physical fitness for employment" in favor of the more logical and more fruitful plan of adapting the work to the measure of individual strength and capacity.

But the realisation of this conception necessarily implies a knowledge of individual value and an appreciation of personal productivity. It implies also the necessity for clear direction, guidance and support under difficult circumstances.

This principle of medical supervision covers all adolescents compelled to work at industrial or commercial undertakings. In the process of advising the adolescents themselves, their parents and their employees, the doctor will create a sense of occupational orientation in the midst of work itself, whilst at the same time pressing his views on individual and occupational prophylaxis.

The document goes on to state that for the greater number, medical supervision will be limited to securing progressive bodily development and the observance of general health principles, but that, in respect to the others, it will be most particular and active; that this intervention will have the effect of apportioning, in the best possible manner, the various kinds of work in accordance with the varying strength and capabilities of the applicants, and will prevent adolescents with defects rendering them particularly liable to accidents from working at dangerous machines or risky processes; that the medical service will keep a careful watch over the weak, and will interest itself in their up-bringing to the extent of influencing the various provident and charitable institutions to render useful and practical assistance during a critical life period; that this health supervision is but an extension of school medical inspection, and that those who are compelled to go directly from the elementary schools to work are as much entitled to this protection as the more fortunate ones who simply transfer to a secondary school.

The draft decree with its introductory note were submitted to the Conseil Supérieur d'Hygiène, which appointed a special committee to consider and report upon the project. The findings of this committee were exceedingly favorable and the writer is of opinion that the views expressed should be quoted *in extenso*. The following paragraphs have therefore been abstracted from the report:

Every child being capable of work, it is necessary to adapt his activity to his powers.

If this principle be admitted it is evident that the individual value of adolescents must be determined from the point of view of their productivity and that choice of occupation must be governed by their physiological properties. It is from this standpoint that occupational orientation must be studied in every case. The proposed regulations only deal with the fringe of this question and in our opinion they could not very well have gone further.

Occupational orientation is, as a matter of fact, being very extensively studied at the present time, and we think that very interesting conclusions will be forthcoming. The knowledge gained in this subject by certain specialists, and also by those responsible for the care and upbringing of war orphans, permits of the assertion that it is extremely useful in choosing a trade to take into account a whole series of physiological and psychological factors, the portent of which is invariably ignored by both children and parents.

Unfortunately the accumulated observations are not yet sufficiently numerous to justify either generalisations or stable conclusions. It cannot therefore be for the present a case of discharging an obligation on something which has been settled by much research work. The future will throw a light on this subject and produce regulations which the hygienist of today can only vaguely visualise.

The necessary consequence of the higher principle marked out is the medical supervision of adolescents in industry. In effect, it is to the interest of society

to secure that the work imposed on the child is not prejudicial to his normal development, while at the same time allowing him to perfect his trade knowledge by devoting himself quantitatively and qualitatively to the occupation chosen. It is essential to move in this matter if adult workers are to attain the maximum of productivity.

To this end the medical inspector will supervise the general development of all young people working in factories. In the case of the more delicate, he should deal with the special necessities of individual cases and must draw the attention of employers to the hygienic measures which ought to be or must be taken to prevent a retrogressive evolution of their apprentices through the influence of inappropriate occupational activity.

The law has made medical supervision of school-children obligatory. Why should it not continue the sanitary control of adolescents in the workshop?

The work of the adolescent is, in effect, often associated with conditions relatively unfavorable to existence; and the period between 14 and 18 years of age is a critical period of life covering the most critical of all, that of puberty.

It is conceivable that, during the course of apprenticeship, numerous troubles may arise and various morbid states can be established which demand immediate intervention and a rapid application of definite hygienic precautions.

Medical supervision then appears to be indispensable. This will not involve a complete sanitary supervision of children, and will not require the application of a complete therapeutical régime to deal with established troubles. It can only bring about a process of clearing away the anomalies produced by occupational methods, and the hygienic orientation of the young. It cannot do more than that, but it will do that.

Actually to wish for more would be to want the impossible. But to obtain what we do ask will secure that every human organism in process of development shall be watched and guided and orientated to the best possible extent.

The sanitary care of adolescents will educate young people in active methods of prevention and treatment; it will also be of assistance to anti-tuberculosis and anti-syphilitic dispensaries in their important social mission; it will be of service to children by directing the sick to the special centers of treatment which are indicated. Doing its work in this manner, such a sanitary supervision will avoid many difficulties in the matter of keeping medical secrets.

Sanitary supervision will be a useful attachment to medical inspection, when this latter is regularly established everywhere. It is quite possible to imagine a system empowering the medical inspector to inspect the school records of his examinees. Some inconveniences will require dealing with, but there is no doubt that, from a health point of view, it is essential that this record, filled in on commencing education, should accompany the youth during the course of his evolution through school and workshop up to his eighteenth year of age.

The medical study of child labor ought not to lead to a definite conclusion on the subject of treatment, for sanitary care does not involve curative medicine. But it will often bring about the acceptance of certain general prophylactic measures which, though not of an obligatory character, have been established by observation. Sanitary supervision will, incontestably, have a marked influence and will thus facilitate the solution of several problems which we can only touch upon here.

It will help to make apprentices understand that they must choose the trade which is most suitable to their state of health, their capabilities and their powers of resistance. It will also assist the disappearance of the evil results brought about by the frequent changes of employment indulged in by young people. It will collaborate in the bettering of apprenticeship, which should become more complete and regular by the fact that children will be selected in accordance with their natural qualifications.

It will lead to the hatching out of many propositions designed to improve the hygiene of youth and to assure perfect nutrition for all. Notably it will help to create projects for the physical education of the working adolescent, projects which in this country are conspicuous by their absence, though necessarily of the greatest interest.

Sanitary supervision, as it is understood in the project submitted to us, has not yet been organised in other countries, — so we think. In many countries, America principally, there is a strong obsession in favor of the certificate of fitness for employment with a view to protecting the adolescent before entering the workshop. But nowhere has it been declared necessary to control the development of the apprentice after entering the workshop.

It is therefore not possible to determine in a specific manner what the program of the new inspection is to be. The actual form which this supervision is to take can only be usefully defined at a later date, when a sufficiently lengthy experience will be forthcoming.

The committee is of opinion that the medical inspector should for the present

follow the lines of examination carried out by school medical officers, involving attention to height, weight and chest measurements, the development of the skeleton, heart and blood vessels, lungs, hernia, eyes, ears, general physical condition, gonorrhea and syphilis.

As the arguments advanced in the reports are fully explained, very little comment is required. They are not new, and most of them have been advanced from time to time during the past fifty years by certifying surgeons in England. Their real value lies in the fact that they are now promulgated by a government department, which has every intention of giving practical effect to all of them. It is quite evident that this intention is a settled policy with the Belgian government.

The writer does not quite agree that there is no contemporary experience to help the Belgian Factory Medical Service in formulating its plan of action. A system of sanitary supervision of children and young persons up to 16 years of age, though not on the same footing as that designed by Belgium, has been in existence in Britain since 1833, and medical occupational orientation was introduced in 1901, when conditional certificates for employment were authorised. Though these systems are not up-to-date and require some drastic amendment, they have created a very large experience in medical examination of young people, and it would appear that the Belgian Medical Service might acquire useful knowledge, not only from the working and results of the more ancient service, but from the obvious defects which require avoiding.

In their plans for industrial reconstruction the Belgian authorities have started at the root. They have fully recognised the basic principle that the C3 factor is an industrial problem, and are convinced that the ill effects of industry are preventable. They are agreed that a process of selection in accordance with physiological capacity is calculated to place workers at the trades to which they are best suited, and that the proper time to effect this selection is the period when a young person enters upon his trade education. They further intend to protect the properly selected worker against the handicap of unhealthy factories by insisting upon every industrial process being carried out under the best hygienic conditions. The Belgian Factory Medical Service has gallantly and whole-heartedly attacked a huge social problem, and the results of the struggle will be eagerly looked for by a large body of well-wishers and fellow workers in the domain of industrial hygiene.

BLOOD CHANGES IN LEAD WORKERS*

ARTHUR SELLERS, M.D., D.P.H.

Lecturer, Practical Comparative Pathology, University of Manchester; Pathologist, Children's Hospital, Manchester; Research Fellow, Public Health Laboratory, Manchester

IN 1914 the writer published some observations on blood changes in lead workers, based on an investigation made at the Public Health Laboratory, Manchester, at the request of Professor Delépine (Jour. San. Inst., Vol. XXXV, No. 7, p. 328). The chief object of the work was to obtain some information concerning the significance of the presence of punctate basophil granules in the red blood corpuscles of workmen exposed to lead. Twenty-six men were examined, all adult males and most of them employees of the Chloride Electrical Storage Company, Clifton Junction. The chief results obtained are stated in the paper published in the Journal of the Sanitary Institute, but owing to lack of space they are not given in full. During the month of December, 1919, through the interest taken by Dr. Macmillan of Prestwich and the kind assistance of the Chloride Company, it was found possible to reexamine fifteen of the men and to obtain some history of others. It therefore seemed advisable to revise the matter and to report the results of the first investigation in 1914 along with those obtained five years later.

Table 1, Part I, gives the main facts regarding the occupation and clinical history of the men taken in 1914. Case 1 was not exposed to lead, his occupation of soaking wood for five years not involving any contact. He had previously been a packer for five years. He may be taken as a sort of control and representing the average type of man employed as regards general physique. Group II comprises men exposed to lead who appeared to be in good general health in 1914 and who gave no history of recent serious illness or lead poisoning. Group III includes men whose general appearance suggested some degree of impairment, such as rather poor physique or signs of anemia, but the difference between the two groups in these respects was not great.

Patients 24, 25, and 26 were men suffering from definite lead poisoning not acquired at the Chloride Company. They were sent for examination in order to have some data for comparison, and at that time were undergoing bath treatment at the Chloride Company's works. Patient 13 was a joiner and had not been exposed to lead to any considerable degree for about two years. He had had a mild attack of lead colic in 1912, being away from work about four months. Previous to that illness he had been working as a packer or at forming and reducing for about seventeen years. His work as a joiner in the works involved only intermittent and slight exposure to lead.

Excluding Cases 1, 24, 25, and 26, the men working under conditions involving exposure to lead were twenty-two in number, all following their ordinary occupations, and the majority being in good health. Four men appeared slightly anemic and three of these men were of rather poor general physique. Their ages ranged from 26 to 59 years, the average being 35; eleven were under 35 and eleven were 35 or over. The nature of their work was such as to involve a considerable degree of exposure to lead. The Electrical Chloride Company manufactures accumulators on a large scale. The men are under careful supervision and the works are adequately fitted with appliances for reducing risk to

* Received for publication July 12, 1920.

TABLE 1.—EXAMINATIONS AND SUBSEQUENT HISTORIES OF TWENTY-SIX LEAD WORKERS

Part I: Examination in 1914							Part II: Examination in 1919
					Blood		
No.	Age	Occupation	Exposure to Lead in Years	General Health	General Findings	Punctate Red Corpuscles	Later History in 1919
				Group I. Not exposed to lead			
1	51	packer, 5 yrs. woodsoaker, 5 yrs.	none	good	normal	none	Same work. In good health. Influenza 14 days. No other illness.
				Group II. Exposed to lead. In good health. No evidence of lead poisoning			
2	30	forming & reducing	10	good	normal	a few	Same work. No illness. In good health.
3	40	forming & reducing	10	good	normal	a few	Same work. No illness. In good health.
4	41	lead burner	25	good	slight anemia, polychromasia	numerous	Left C.E.S. in 1915. Good health. Same work.
5	27	caster	10 mos.	good	normal	a few	Slight lead colic 1918. Now in good health. Same work.
6	38	paster	4	good	normal	numerous	Same work till 1914. Enlisted. Killed in France.
7	44	furnace man	1½	good	normal	numerous	Same work till 1914. Served in France. Rheumatism for past 9 mos.
8	26	sawyer	7	good; rheumatic fever 5 yrs. ago	normal	none	Same work. Good health. Slight coal gas poisoning 2 years ago.
9	29	tape machine	15	good	normal	none	Same work. No illness. Served in France June, 1916, to March, 1919. Shrapnel wound of abdomen.
10	27	trimmer	7	good	normal	a few	Same work. No illness. Good health.
11	26	sawyer	8	good	normal	none	Same work till Sept., 1918. Lead colic Sept., 1918, to July, 1919. Woodsoaker since. In good health.
12	40	plate stores	16 mos.	good	normal	moderate	Left C.E.S. soon after 1914. No further history.
13	42	packer; forming and reducing	17	lead colic in 1912; ill 4 mos.; joiner since recovery	normal	moderate	Still joiner. In good health. Slight exposure to lead occasionally.
14	31	plate filler	14	typhoid 1908; good	normal	moderate	Left C.E.S. in 1914. Became window cleaner. Now in good health.
15	30	caster	6	good	normal	a few	Same work till 1915. Enlisted. Served in France. In good health.
16	35	caster and packer	15	good	normal	numerous	Same work. Good health. No illness. Submarine work about 8 months, ceasing 4 months ago.
17	36	caster	11	good	normal	very few	Now foreman. Good health. No illness.
				Group III. Exposed to lead. Some evidence of slight ill health or defective physique			
18	30	caster	15	slight anemia, good health	slightly abnormal	numerous	Same work. In good health. Influenza 14 days. No other illness.
19	48	tape machine	20	good slightly anemic	slightly abnormal	numerous	Same work till Jan., 1914. No lead poisoning. Died Feb., 1914, from "rupture" and "neuritis."
20	31	caster	18	good slightly anemic	normal	numerous	Same work. No illness. In good health. Submarine work Sept., 1915, to April, 1916.
21	27	moulder	15	good, rather poor physique	polychromasia	moderate	Same work. Charge hand. Good health. Ill 5 weeks with influenza.
22	59	caster	17	good poor physique	normal	moderate	Same work. No illness. Good health.
23	35	caster	16	anemic poor physique	poikilocytosis and polychromasia	numerous	Same work. In good health. Stronger than in 1914. Food poisoning caused by bacon, 3 months duration, Dec., 1917.
				Group IV. Cases of definite lead poisoning			
24	37	house painter	24	lead colic; ceased work Nov., 1913	normal	a few	No history.
25	—	painter	25	lead colic, paralysis; no exposure for a month	normal	moderate	No history.
26	57	plumber	many years	exposure ceased 4 mos. ago; lead colic and paralysis	normal	a few	No history.

TABLE 2. — RESULTS OF BLOOD EXAMINATIONS IN 1914

No.	Red Cells per C.Mm.	White Cells per C.Mm.	Per Cent. Hb	Color Index	Differential Count of Leucocytes Percentage of Cells: Poly-morpho-nuclears	Lymph-ocytes	Large Mono-nuclears	Eosin-ophiles	Punctate Red Cells	Remarks Appearance in Stained Films
					Group I					
1	4,924,000	8,000	90	1	72	23	4	1	none	Normal.
					Group II					
2	4,824,000	8,000	80	.8	71	25	3	1	a few	Normal apart from punctate reds.
3	4,708,000	8,000	84	.9	70	25	3	2	a few	Normal apart from punctate reds.
4	3,748,000	8,000	60	.8	65	30	4	1	numerous	Some polychromasia.
5	4,032,000	8,000	84	1.0	76	15	8	1	a few	Practically normal.
6	4,148,000	8,000	65	.8	61	36	2	1	numerous	Normal apart from punctate reds.
7	4,244,000	8,000	70	.8	60	33	6	1	numerous	Practically normal apart from punctate reds.
8	5,040,000	6,000	90	1.1	70	23	4	3	none	Normal.
9	5,024,000	6,000	80	.8	76	20	3	1	none	Normal.
10	5,200,000	9,000	70	.7	74	22	3	1	a few	Normal apart from punctate reds.
11	4,800,000	7,000	68	.7	57	38	4	1	none	Normal.
12	4,364,000	8,000	80	.9	58	37	4	1	none	Normal.
13	5,100,000	7,000	90	.9	72	19	8	1	moderate	Normal apart from punctate reds.
14	4,320,000	6,000	74	.8	79	17	3	1	moderate	Normal apart from punctate reds.
15	5,268,000	5,000	95	.9	57	34	3	6	a few	Normal apart from punctate reds.
16	5,248,000	6,000	85	.8	65	29	5	1	numerous	Normal apart from punctate reds.
17	5,116,000	6,000	95	.9	65	34	3	2	a few	Normal apart from punctate reds.
					Group III					
18	3,728,000	8,000	75	1.0	56	37	6	1	numerous	Some polychromasia.
19	3,302,000	8,000	75	1.1	79	17	3	1	numerous	Some polychromasia.
20	3,444,000	8,000	65	1.0	73	23	3	1	numerous	Normal apart from punctate reds.
21	5,100,000	9,000	84	.8	73	24	2	1	moderate	Some polychromasia.
22	4,688,000	9,000	80	.8	70	22	2	6	moderate	Normal apart from punctate reds.
23	3,792,000	7,000	64	.8	63	34	3	1	numerous	Some poikilocytes and polychromasia.
					Group IV					
24	4,400,000	6,000	85	1.0	70	23	2	5	a few	Normal apart from punctate reds.
25	4,200,000	6,000	90	1.1	83	14	2	1	moderate	Normal apart from punctate reds.
26	4,360,000	5,000	82	1.0	58	34	6	1	a few	Normal apart from punctate reds.

a minimum. The duration of exposure varied between ten months and twenty-five years. The men were not picked men as regards general physique. They were merely selected as examples of men who had been exposed to lead for fairly long periods of time.

Blood Examinations

Methods.—The blood was usually taken from the ear, in a few cases from the finger, and the usual precautions were observed. In 1914 the red cells were counted with the Thoma-Zeiss apparatus and the white cells

were counted in the same drop of diluted blood as the red cells. The hemoglobin estimation was made with the Miescher modification of the von Fleischl instrument. Dried film preparations on slides were stained by (1) Leishman's stain, and (2) methylene blue after a method advocated by Ruelens.*

In 1919 similar methods were used, except that the white cells were counted by means of the ordinary white counting pipette and dried film preparations were stained by the *post-vitam* method as well as by Leishman's stain and methylene blue. On both occasions the results of the differential count of the leucocytes were based on a count of 250 cells. It was considered advisable to restrict the methods to those in ordinary use for clinical examinations.

The full results of the blood examinations made in 1914 are given in Table 2. Excluding Cases 1, 24, 25, and 26, the following is a summary of the results of Table 2: In 5 cases the red cells were below 4,000,000 per c.mm.; in 18 cases the hemoglobin was below 90 per cent. of the normal; in 17 cases the color index was below 1.0; in 18 cases punctate red cells were present; in 5 cases the blood was somewhat abnormal as seen in stained films.

As regards the leucocytes, the changes were not striking. The chief peculiarity was a relative increase in large mononuclear cells. This term includes the different types of cell classified into several varieties by many authorities. No abnormal leucocytes were found. In some instances there was a diminution in the number of polymorphonuclear cells with an increase of the lymphocytes. A moderate degree of eosinophilia was found in two cases and in both of these punctate reds were present.

The changes present in Cases 24, 25 and 26 (all lead poisoning) were similar to those seen in the other cases, but were not of a very pronounced type. All three men had clinical signs of lead poisoning of a fairly severe kind, but exposure to lead had ceased some time before the examination was made, and they were apparently recovering.

Two definite and easily recognisable blood changes were present in a very large proportion of the cases: (1) a diminution of the hemoglobin, (2) the presence of punctate red cells. As regards the latter condition, the histories of the men showed that it was frequently associated with either a blue line on the gums or a previous history of more or less of a blue line at intervals. In two instances punctate reds were present without any blue line either previously or at the time of examination. In one case a fairly well-marked blue line was seen at the time of examination, but no punctate red cells were found. Thus there was no constant relation between the two conditions.

The granulations may appear after a fairly short exposure to lead, but the present series does not include any case with an exposure shorter than ten months. After they have appeared, they may persist for a considerable length of time after exposure has ceased. Thus, in the three cases of lead poisoning they were found one, four, and eight months after exposure had ceased, and in one instance (Case 13) two years afterwards, though in this instance there was possibly some slight degree of exposure at the time of examination. The number of granulations was small in the lead poisoning cases and afforded no index of the severity of the other signs and symptoms.

In Group II, Table 1, comprising sixteen men, the punctate reds were numerous in 4 instances; moderate or few in 9 instances; and not found in 3 instances. In Group III, comprising six men, the punc-

* Fix in absolute alcohol 15 minutes. Stain 2 minutes. Wash in distilled water till the film becomes pale greenish.

Methylene blue (med. pur.)	1 gm.
Bicarbonate of soda	6 gm.
Distilled water	200 c.c.

tate reds were numerous in 4 instances and moderate or few in 2 instances. On the whole, it appears that punctate reds were somewhat more frequently found and in rather larger numbers in men showing some sign of defective health than in healthy individuals.

During the past five years the writer has examined at least fifty films of blood from healthy persons, including adult males and females and children, not exposed to lead. Punctate red cells are found very rarely and in very small numbers in apparently healthy individuals. They occur fairly frequently in various diseases and in cases of poisoning by other agents than lead, but apart from clinical details it is usually easy to recognise a film of blood from a lead worker. The punctate red cells are comparatively numerous. Frequently several are seen in almost every field. The corpuscles containing the granules appear sometimes a little larger than the normal ones but not invariably, and they sometimes stain in slightly abnormal fashion, showing an increased affinity for the blue stain. The granules are sometimes very minute and numerous so that the corpuscle appears as if it were dusted over with a fine powder. Frequently they are larger and less numerous and appear as rounded or slightly irregular blue dots not uniform in size, each corpuscle containing a number of granules, varying from six to twelve or thereabouts. The granules appear to be situated mostly in the periphery of the corpuscle. Various artefacts are seen in a badly made film preparation but there is no real difficulty in recognising the punctate red corpuscles.

At one time it was suggested that a diagnosis of incipient or definite lead poisoning could be made if the punctate red cells exceeded a certain proportion relative to the normal red corpuscles, and two standards were proposed, namely, 100 per million and 300 per million. Table 3 gives a summary of the results of counting the proportion of punctate red cells to the normal corpuscles in the twenty-one cases in which they were found. The enumeration was made by an Ehrlich's stop, fifty fields being counted and the proportion estimated in the usual manner. The proportion was not large in any of the cases of lead poisoning — about 100 per million. The largest number was found in Case 23. This man was fairly muscular and of good physique, but rather anemic looking. He had

TABLE 3. — PROPORTION OF PUNCTATE RED CELLS TO NUMBER OF RED CORPUSCLES

Number of cases	21	
Less than 100 punctate cells per million red cells	3	(14 + %)
More than 100 punctate cells per million red cells	4	(19 + %)
More than 300 punctate cells per million red cells	14	(66 + %)

been a lead worker for sixteen years without any serious illness. About the time the examination was made, he was suffering in general health from loss of sleep and mental anxiety due to the fact that he had to nurse his wife who was suffering from cancer.

On the basis of the blood examinations it might be suggested that some of the men were in a critical state; i. e., either actually suffering from lead poisoning of a mild type or threatened with an attack. In fact, it might be urged that there were only five cases (Nos. 8, 9, 11, 12 and 21) where fairly definite changes were not present. If the standard of 300 punctate red cells per million were accepted, at least fourteen men would have been suspended from work. On referring to Table 1, Part II, it will be found that in only two instances was there a history of lead poisoning subsequent to 1914. In Case 5 there was a history of slight lead colic, but it did not occur till 1918 and apparently recovery was rapid. Case 11 also had an attack lasting from September,

1918, to July, 1919, when he resumed work. This man, however, was one of the few who showed practically no blood changes in 1914. It therefore seems clear that the examination of blood films as a routine measure for the control of lead workers, whether undertaken on an estimate of the proportion of red cells containing punctate granules or not, would give results which would operate very unjustly both for the workmen and the employer. It is probable that many incipient cases of lead poisoning would escape detection, and it is certain that many men in good health would be excluded from their work.

During the month of December, 1919, the writer was able to re-examine fifteen of the men and to get some history of the rest. The men examined were Cases 2, 3, 8, 9, 10, 11, 13, 16, 17, 18, 20, 21, 22, and 23. The clinical histories of the men between 1914 and 1919 is given in Table 1, Part II. Most of them had continued to follow the same or similar employment or at all events had worked under conditions involving more or less exposure to lead. One man worked only till January, 1914 (Case 19). He died the following month from "rupture" and "neuritis," but nothing more definite could be ascertained. Patients 5 and 11 who had lead colic have already been discussed. In both these cases the blood examinations made in 1914 revealed slight changes only and clearly not such as to indicate incipient lead poisoning. In some instances work was interrupted by military service. Case 23 is especially interesting. This man, in 1914, had very decided blood changes and looked ill, but he was never suspended and did not develop signs of lead poisoning. In 1919 he appeared in a good state of health. The conclusion seems irresistible that blood examinations give but little information of value in determining incipient lead poisoning in workers exposed to lead.

In five instances a blue line was present more or less, at intervals in the period between 1914 and 1919. A blue line and punctate reds have the same significance. They indicate absorption of lead and are not necessarily signs of actual lead poisoning. The writer's impression was that, on the whole, the men were in a better state of

TABLE 4.—RESULTS OF BLOOD EXAMINATIONS IN 1919

No.	Red Cells per C. Mm.	White Cells per C.Mm.	Per Cent. Hb	Color Index	Differential Count of Leucocytes Percentage of Cells				Punctate Red Cells	Reticular Red Cells	Remarks
					Polymorphonuclears	Lymphocytes	Large Mononuclears	Eosinophiles			
1	4,960,000	5,500	90	.9	66	30	3	1	none	none	Normal.
2	5,000,000	5,600	80	.8	75	23	1	1	a few	none	Nearly normal.
3	4,000,000	8,200	80	1.0	67	29	3	1	none	a few	A few abnormal leucocytes.
8	4,800,000	7,300	90	1.0	67	30	2	1	none	none	Normal.
9	5,040,000	8,300	84	.8	66	30	3	1	none	none	A few abnormal leucocytes.
10	5,080,000	4,700	80	.8	63	35	1	1	none	none	Normal.
11	3,844,000	5,900	76	1.0	65	30	4	1	none	none	A few abnormal leucocytes.
13	4,800,000	6,000	90	.9	77	19	3	1	none	none	Normal.
16	4,400,000	8,600	70	.8	70	27	2	1	none	a few	Nearly normal.
17	4,900,000	6,100	90	.9	61	37	1	1	none	none	Normal.
18	5,000,000	5,600	80	.8	75	23	1	1	a few	none	Nearly normal.
20	3,828,000	7,800	70	1.0	77	20	2	1	none	a few	Nearly normal.
21	4,260,000	8,900	76	.9	73	24	2	1	moderate	none	Nearly normal.
22	4,900,000	5,600	90	.9	73	25	1	1	none	none	Normal.
23	4,620,000	4,700	76	.8	78	19	2	1	none	none	A few abnormal leucocytes.

health in 1919 than in 1914. The explanation of this is not obvious, but possibly it was due to increased pay and better food.

The results of the blood examinations made in 1919 are given in Table 4. The following is a general summary of these results: The red corpuscles were below 4,000,000 per c.mm. in 2 cases; the hemoglobin percentage was below 90 per cent. in 10 cases; the color index was below 1 in 11 cases; the leucocytes were somewhat increased in 7 cases; punctate red cells were found in 3 cases; granulo-reticular red cells were found in 3 cases; a few abnormal leucocytes were found in 4 cases.

There was a slight degree of anemia in Patients 11 and 20, but both these men appeared in good health. The blood examinations, on the whole, showed some improvement as compared with the results obtained in 1914.

It is a matter of regret that the *post-vitam* method of staining was not adopted in 1914 in addition to the other methods. This method does not seem to be much used as a general routine method of clinical examination in this country. It is an old method and the writer has found it very useful. It is very simple, requires no special apparatus and displays some features not recognisable by other methods. It is specially suitable for the detection of punctate red cells.*

There is no general agreement as to the nature of the punctate red cells in the blood of lead workers. Some authorities regard them as degenerative products. Others consider that they afford evidence of regeneration, not of a perfectly physiological character and therefore indicating a slightly abnormal state of the blood-forming organs. The presence of granulo-reticular forms is strongly in favor of this view since, practically speaking, they are not present in the blood of healthy adults. This series of cases offers a good example of toleration to the toxic effects of lead absorption and one is tempted to suggest that the men who are most likely to develop a tolerance are those in whom the absorption of lead excites the production of punctate red cells, because their blood-forming tissues are capable of responding to the stimulus.

The diagnosis of a case of lead poisoning often presents great difficulty and is usually a matter of inference based on a minute clinical examination. Many cases are perfectly clear from the outset and, therefore, do not become the subject of legal proceedings. It is the obscure and doubtful cases which come under the Workmen's Compensation Act. It would surely be a great benefit if some really reliable means could be found, apart from the symptoms and statements of the man himself, which would enable a medical man to say in any particular instance, "This is," or "this is not a case of lead poisoning." Blood examinations are quite unreliable. They do not afford a definite criterion one way or the other. Some cases of lead poisoning do not show readily recognisable changes in the blood and, on the other hand, definite changes may be present without any other sign of lead poisoning. A blood examination in a case of suspected lead poisoning is only one of numerous other pieces of evidence which must all be considered critically in order to arrive at a diagnosis.

The writer desires to thank Professor Delépine, Dr. Macmillan and the Chloride Company for assistance in various directions.

* A full description will be found in *Traité du Sang* by A. Gilbert and M. Weinberg, Paris, Bailliere, on page 146. Make an ordinary wet film preparation on a slide. Put a drop of 1 in 500 methylene blue on a cover glass. Drop onto the slide. Lute the edges.

THE ART, NOT THE SCIENCE, OF INDUSTRIAL MEDICINE*

C. C. BURLINGAME, M.D.
South Manchester, Conn.

I HAVE attended so many meetings of specialists on so-called industrial relations, employment management, service management, etc., that my mind is in a whirl. The ideas of the different men seem so much at variance, and still all claim to hold the panacea for industrial unrest, that I feel entirely at a loss to know whom to believe. Out of it all, however, there comes distinctly to my mind one thing — that the average American workingman is and wants to be independent. He does not desire to be an object of charity.

This independence of the American workingman was typified in the American doughboy in the Great War; an experience I had in Italy will illustrate the point. We had an ambulance section with the Italian army and it used to be the favorite pastime of this ambulance section to pass up and down Mont Grappa in the middle of the night, going 20 or 30 miles an hour, over a road which I hardly dared ride over when anyone else was on it. On one occasion one of these ambulance cars was out of order and the doughboy in charge of it was lying flat on his back under the car, pounding away in an effort to make the needed repairs. It so happened that the King of Italy passed by and, stopping, said, "I say, what is the matter with your car?" Without even looking out from under the car, the doughboy said, "What the hell business of yours is it what's the matter with this car?" The King replied, "Why, it's none of my business — I was merely trying to be pleasant." From under the car came, "And who the hell are you?" The King answered, "Why, I'm the King of Italy." The pounding did not stop, but from under the car came, "Well, what the hell do you think of that?" This is a true story, I can vouch.

My next story is told, not to show any irreligious tendency, but to bring out the independence and the initiative inborn in the American workingman. I was visiting the catacombs near Rome, and a saintly old priest, telling me of a visit which he had been paid by an American doughboy, said, "These American doughboys have no respect for anything. One was here but a short time ago and I pointed out to him that light and said, 'That light has been burning for two hundred years and has never been out.' He turned around, puffed at it, and said, 'It's out now.'" Can you imagine such men as these wanting any charity from their employers or any "soft" welfare work?

After this digression, I come back to my subject, "The Doctor's and Nurse's Part in Industry." If we, as doctors and nurses, stop to think, we ask ourselves what is our business in industry. Are we in industry to do a charitable act for a kindly disposed employer? Are we in industry to stabilize labor? Are we in industry to make one plant more attractive than another which has no medical supervision? Are we in industry to help carry out some soft, silly, social plan? In my opinion, none of these motives explains our presence in the industrial world. Are we in industry then to buy the goodwill of the employee for the employer or perhaps to gratify an employer's desire to do a community service? Again

* Address given privately to a group of physicians and nurses in industry. Received for publication Aug. 23, 1920.

I say no — these should not be the reasons for our presence here. A change of owner or a change of mind of the present owner would leave us out of a job which, in itself, would not be important, but would make us feel that the work we had done was not a real and permanent contribution to society.

If we grant all that I have said as true, we must then ask ourselves again why we are in industry. In attempting to answer this I fear you will accuse me of being mercenary and cold-blooded, but if you follow me through I believe I can disabuse your minds of such belief.

We are in industry because it is good business. We are in industry to reduce the employer's loss from ill health among his employees — ill health leading to idle machinery, lowered production, etc. The cost of sick employees is too great to permit the taking of no steps to limit the amount of sickness. A medical department is, moreover, essential in industry for the proper carrying out of any scheme for placing men on the jobs for which they are physically fit.

Another of the duties of a doctor or nurse in industry is to protect the employer's rights under the compensation acts and to take care, more economically and more efficiently, of patients for whose professional care the employer is legally liable. A doctor and nurse in industry are essential to the economical and proper conduct of any insurance scheme in which the company participates with its employees. Without such control the insurance scheme would be expensive both in money and in lowered production due to abnormal absences from work.

All these reasons should constitute a good business proposition without frills, that is, a business proposition which resolves itself into safeguarding the health of the employee — this being one interest which capital and labor have found they have absolutely in common. In spite of the fact that this is a business proposition, we find that by meeting these obligations an employer reaps benefits along with his employee which neither of them commonly expects from a strictly business relation.

Granting that the employee's health is a common interest to both the employer and the employee, we next ask ourselves what relation the doctor and nurse must now occupy. Let me say in the beginning that the responsibility of the doctor and nurse is — first, last and always — to their patients. The mere fact that a doctor and nurse have entered industry does not in any way relieve them from the sacredness of their professional obligations. Incidentally, if a strictly professional relation between doctor and patient is maintained, and not the relation of employer and employee, the company will profit most. We cannot expect to have a doctor and a nurse do their best in getting a patient well and keeping him so unless they have the full confidence of the patient. Nor can we expect this full confidence from the patient if the doctor and nurse have converted themselves into a medical police force operating in the pay of the company, or if the patient feels that all his personal confidences are to be passed on to the foremen and superintendents.

I therefore urge upon you to take into consideration the things which you cannot do if you are going to maintain the purely ethical and professional relations which you have accepted. You cannot violate the confidence of patients because you are being paid by someone else for rendering this service to them. You cannot become a medical police force without losing the standing you should have with your patients, and you most certainly will not be able to deliver the service which the company has a right to expect of you. You cannot be unethical with outside practitioners or nurses just because you feel

assured that your salary will continue in any case. You owe something to the medical profession and the medical profession owes something to you.

Your position is unique and, because of this fact, you will be more subject to criticism than the man or the woman in the more common types of practice. In the end you will win more by being the best example of ethical practice in your community. You cannot rightfully expect to hold patients except by doing professional work which will merit their confidence. Unless you pay attention to this point you are putting yourself in the class of the doctor or nurse who does cheap routine work because his salary is assured.

You have no right to look to the company to use any force or compulsion to make patients come to you. If the patients do not want to come to you because you are a good doctor or a good nurse, you do not deserve to have patients. We decry the elimination of competition in all business. We legislate against elimination of competition in big business. Why, then, should we look to our employer to use compulsion to force patients to come to us rather than to a private practitioner? May I, then, emphasize the point that you cannot afford to be anything but the best professional people in your community and, if possible, bear the reputation of doing the best professional work. If you do not keep up to this standard, industry will lose you. The day has gone by when big business employed the cheapest lawyer it could get. The corporation counsel is usually the best man in the country. The corporation medical advisors ought eventually to be on the same plane, and they are fast getting there.

As a matter, then, of good business, not of charity, what ought a medical department include? In my opinion, a good industrial medical department should include: first-aid rooms; a medical clinic fully equipped with X-ray and clinical laboratory to do the best medical and surgical work; a dental clinic with educational features in order to round out and perfect the diagnostic features of the medical clinic; a service of safety and sanitary inspection to look up all accidents occurring in the mills and to cooperate with the engineering department in ordering safety devices, to make sanitary inspections of all the company's properties, and to see to it that insanitary and unsafe conditions and fire hazards are eliminated. I suggest also the providing of a district nursing service, which should be maintained as a nursing service, not as a service for investigating and spying upon employees. My own experience in watching both plans operate has led me to have a very strong conviction against the advisability of using nurses to investigate causes of absences, etc. This work should be done by somebody entirely out of the professional group caring for the health of the employees.

In the larger companies a service of occupational research ought to be maintained. It seems to me very unfitting that the study of relation between disease and occupation be left entirely in the hands of professors at the universities. No matter how well qualified these men may be, the best work cannot be done with the home in one place, the work in another place, the sick man in another place, and the professor who is working out the conclusion in still a fourth place. The ideal position for relating disease to occupation demands that the study be made by a person who lives with the workman, who works with the workman, who treats the workman, and who has a scientific staff in this same relation. Industry should, therefore, take its part in solving these scientific medical problems and it will pay industry in dollars and cents to do so.

I might add also, as a component part of a medical department, a day nursery, al-

though I am not converted to the day nursery idea under all circumstances.

I will not talk at greater length upon the operation of these various branches of a medical department, but would like to point out some of the things which may make for the success of the department as a whole. Some of these points I have already mentioned, one being to maintain always strictly confidential and professional relations with the patients and never to have records accessible to the company except under exactly the same conditions as the records in a physician's private office would be available.

It is highly essential that the medical department itself should never reject any applicant for work except when that applicant has been found dangerous to himself, to others, or to property. No diagnosis should ever be given out except to the patient, whether the patient has already entered the employ of the company or is an applicant. When an applicant has been examined for work, the type of work should be recommended by the physician, who is then acting as the medical advocate of the applicant. The physician should state to the employment bureau what type of work is desirable and what types of work would be to the physical disadvantage of the applicant. The diagnosis should never be given to the employment bureau except upon the request of the applicant.

My next bit of advice will give you a chance to laugh at me. Have attractive assistants. Remember that when a person comes to the medical office he is usually coming because he is sick, and with sickness go irritability and a feeling of being on edge. Now I ask, if you were in that frame of mind and stepped into a doctor's office and found an old crab there to scowl at you, do you think you would feel better or worse? If, however, you were met by someone who smiled and had an attractive personality, was sympathetic and took your grunts with a smile, do you think you would feel better? This, then, is just one of the points in the art of the practice of medicine as distinctive from the science of practice, and the same thing holds true in private practice as well as in industry.

Have only the best equipment — that makes for success and good business. Considering the number of patients you will be called upon to take care of, you cannot afford to have poor equipment nor to let it run down. Remember not to get so busy that you forget the place is getting dirty and grimy, and not to be so filled up with success that you forget you look seedy. Don't turn out lights for the sake of saving electric light bills when it is going to make the place look gloomy. A sick man feels gloomy in a gloomy place.

Have a good business system, have good records, and have them well kept. When a patient steps into a doctor's office it is a comfort to him to have the doctor say, "Why yes, you were in to see me three months ago and had — such a thing — the matter with you." This is not deceiving the patient — it is merely using the record to remind yourself about that patient's previous condition, and it at once establishes a close personal relation between you and the patient.

Do the best work in the community and let it be known that you do it only through the work itself. The character of a man's work is the best advertisement which he can have. And as long as you are a doctor, and as long as you are a nurse, remember that you have a medical obligation to *smile, smile, smile.*

The whole problem divides itself quite logically into the responsibility of the employer and the responsibility of the employee. Up to the present I have been describing how the employer should meet his responsibility, and now I wish to ask you how we can get the employee to assume his responsibility. Of the two, it is far easier to

convince the average employer — the average modern thinking business man — of his responsibility. This he can and usually will meet by the appropriation of money to provide adequate personnel, materials, and the correction of certain physical layouts which are a menace to health. Then, too, the law has stepped in to encourage the employer in meeting his responsibility, while the employee's responsibility can only be met by the employee unaided.

How can we get the employee to take an interest in and to look after his own health? There is only one way, and that is almost exclusively by education. Printed matter with pictures and reminders and funny stories is, to my mind, of very doubtful value, and I think its dissemination by employers is possibly open to the criticism of being too paternalistic when it concerns the community health as distinctive from industrial health. Lectures are poorly attended as a rule. I cannot conceive of enough people attending a lecture on "How to Clean Your Teeth" to warrant spending any money in advertising such a lecture. Of all this class of educational work, pictures are probably of the greatest value, but I do not know how much value these are — certainly not a great deal.

The greatest and most enduring effort is not by any short cut or wholesale method. It is through personal contact established by a good medical department enjoying the confidence of employees, by the daily advice of the doctors and nurses to the individual patients given when they are in receptive mood. Except in an epidemic, I do not believe you can get very many well people to read about health or listen to lectures on it, but people will listen when they are sick. I have often asked myself why this is the case and I have said to myself, "It is because people can seldom visualize themselves as sick, and no one can ever really visualize himself as dead." I have come back, therefore, to the belief that the best method of health education is to take the sick man and tell him why he is sick and what will prevent his being sick in the future. He will believe the things you tell him, and will pass them on to someone else — and so it goes. No short cuts — a lot of work and personal confidence is necessary.

In concluding, I wish to call to your attention the possible by-products of a good industrial medical department. If the doctor has stayed doctor and the nurse stayed nurse, the employer may get as by-products some of the following: He may have learned to know his employees better; his employees may have learned to know him better; he may have received their increased confidence and have established a most desirable avenue of approach to them which could not be duplicated in any other way; and, finally, he may have accomplished a lowering of his labor turnover. But these should not be the reasons for establishing a medical department. It is most essential that an employer should not confuse the by-products with the really basic reasons for establishing the department.

And to you, as doctors and nurses, I say, be proud to be still the doctor or even the "doc," and to be the nurse or "Miss Nursie" all of the time.

In closing, I am going to give to you a schoolboy oath, which has in it, however, certain fundamental truths which you, as doctors and nurses, should not forget just because you have entered industry. This was an old fraternity charge which has stayed with me through all my professional life:

> Worthy Candidate, you are now engaged in the study of medicine, the art of healing, which is, with the possible exception of the ministry, the noblest calling within the scope of human attainment. You will be called upon in the exercise of your profession to guard the mortal part of man, ever bearing in mind that it is formed in the image of its Maker. You

will ofttimes stand between man and his God, the only barrier between him and the dark river which none recross. You will usher into this world of sin and suffering the wee small babe whose very life, frail as the finest thread, will depend upon your skill. In old age, when skill has proven of no avail, you will close the eyes of this mortal frame and consign its immortal occupant to the world from which it came. Do not then yield to any temptation to prostitute your abilities for earthly gain, but so conduct yourself that when the final summons shall come from the Almighty Healer it may of you be said: "Well done, thou good and faithful servant, enter thou into the joys of thy Lord."

HYGIENIC INSTALLATIONS IN MODERN INDUSTRIES*

LOUIS DEJARDIN

Honorary Director General of Mines, Belgium

It is not a very long time since the hygiene of workplaces and the well-being of the workpeople, who pass the greater part of their lives there, were, in this country, relegated to the background not only by public bodies and employers of labor, but also by the workpeople themselves. The royal decree of Feb. 28, 1863, dealing with the regulation of dangerous, unhealthy and unwholesome trades, did not secure from a purely hygienic point of view any definite improvement; it was left to the decrees of 1886, 1894 and, finally, to that of 1905, to fix general conditions governing the hygiene of workplaces, proper maintenance and cleanliness, and to prescribe certain hygienic installations. Again, among the requirements of the later decrees, those which concern cloakrooms, lavatories and mealrooms can only be enforced in certain scheduled unhealthy industries. But during the past twenty-five years public opinion on these matters has changed considerably. The establishment of a Ministry of Industry and Labor, the measures brought forward on its initiative, and the resolutions passed at the International Congress of Hygiene and Democracy, held at Brussels in 1903, are sufficient to prove this statement. The workpeople themselves have a better understanding of the necessities of hygiene. Far from being opposed, as they were for a long time, they have become ardent advocates of the new system, and willingly call for its speedy application. Further, the recent re-organization of the medical inspection of factories, now transformed into an autonomous Factory Medical Service, and the ability of the men placed at the head of the service are a sure guarantee that the question of establishing and maintaining hygienic installations for the use of workers will be minutely studied in the future.

It is my desire to present to you a short sketch of the different installations, which, in my opinion, and in the light of present day knowledge, should be established from a hygienic point of view in all industrial establishments, whether large or small; and afterwards to say a few words about the housing of the industrial population. I shall, however, place upon one side, as foreign to my subject, such important questions as heating, ventilation, lighting and cleansing of works. These questions necessitate special studies which it is not my intention to enter upon here.

However important or however modest may be the workshop or factory providing the employment, the workpeople should find, on arrival and sufficiently near the entrance, a secure and convenient place for changing from outdoor attire to working dress, and where any object of value can be left in security. These cloakrooms should be roomy, well ventilated, well lighted by day and night, and comfortably warm. They should be provided, to a number corresponding to the workers employed, with metal lockers, simply and solidly constructed and provided with a key; they should be furnished with benches and serve as restrooms in cases of indisposition or during temporary stoppage of work. Adjoining or inside the cloakroom, according to the importance of the establishment, lavatories should be provided. The necessity for the worker to wash his face and hands regularly before taking a meal should be recognised and the practice established as a universal custom. To

* An address delivered at the Congress of the Royal Institute of Public Health, held in Brussels, May, 1920. Received for publication August 23, 1920.

facilitate this it is necessary to place at his disposal simple and well-constructed washing accommodation. Metal troughs with tip-up basins furnished with separate taps, all of solid construction, should be ample for the purpose.

Contiguous to the local lavatories, or at least within easy distance, the mealroom should be established. In these days it is not permissible for the worker, in the interval between his working hours, to be obliged to take his meal in the corner of the yard or in a passage of the factory, exposed to heat in the summer and to cold and rain in winter, or compelled, if allowed to go outside, to seek refuge within one of the numerous beer shops of the neighborhood. The mealroom, simply fitted up, should be a bright apartment, well aired, well lighted, well heated and provided with plain tables and seats to a number corresponding to the number of employees who will be likely to use it at one time. In addition to the furniture, it should be provided with ovens and heated tables for the workpeople to warm their meals, as well as hot-water kettles and urns for the preparation of coffee or other suitable hot drinks, and fitted with taps supplying potable water of absolute purity. In my opinion, it would be ideal to provide, alongside the dining room, a proper kitchen, where a warm substantial meal could be cooked for the workers at a moderate price. In the light of experience gained in communal kitchens during the war, certain employers are disposed to take up this idea.

Installations so important as those of water closets and urinals should be provided in a separate pavilion. These fitments should be the object of particular care both in setting up and in maintenance. At present several types of closet with automatic flush are in existence, and, in the absence of proper sewer provision, septic tanks can easily be provided. These particular installations, which I regard as an indispensable minimum, can and ought to be established without unnecessary embellishment, but with an air of suitability which will induce, or, shall I say, oblige those who use them to keep them in perfect condition. It is necessary to educate workpeople in cleanliness, and this education should be a mutual undertaking. The workman ought to make it a point of honor to see that places fitted up for his exclusive use are maintained in good condition. To this end he should repress any slackness on the part of his fellow workers, who might be inclined through ill nature or in a boyish prank to damage or dirty the fittings. I have noticed that the placing of inscriptions on the walls of cloakrooms and mealrooms is useful in impressing upon workers their common obligations. It goes without saying that in any establishment employing both sexes, these installations must be duplicated, their scale and extent varying with the respective numbers of males and females normally employed.

It may appear strange that, up to now, I have not mentioned shower-baths; it is not that I have forgotten them, for among modern hygienic installations I regard them as of first importance, but because, however desirous I may be to see their general adoption, I do not think they are indispensable in all industries. By the very nature of his work, whatever it may be, the skin of the manual worker is bound to become covered quickly with impurities prejudicial to the proper carrying out of the functions of this organ. The sole means of clearing them away economically, rapidly and easily is the shower-bath. It is then desirable that establishments of sufficient magnitude should provide shower-baths for their workpeople, and habituate employees to their frequent, if not daily, use.

Up to this point, I have dealt only with installations for the use of healthy workpeople. Modern industry unfortunately carries in its train a series of accidents more

or less severe which, in their turn, call for special measures. I well know that the workshop and the factory are scarcely the most suitable places for curing wounds, but as a first-instance measure or to bring about the safe transference of the injured to the appropriate dispensary, every industrial establishment should possess a special equipment, always available, day or night, to enable the victims of industrial accidents to receive the appropriate first aid and dressing which, without detriment to proper treatment or risk to life, will secure their conveyance in comfort to clinics provided with every appliance necessary for up-to-date treatment. The extent of the first-aid provision will necessarily depend upon the size of the factory, its topographical situation and its distance from or proximity to hospitals or clinics. It is for the medical personnel to fix the exact requirements which these places must fulfill.

My preceding remarks have had relation to industry in general. There are in existence, however, in our country, a number of particularly unhealthy trades which demand special attention from the hygienist. A complete list of these would be too lengthy to give. I ought, however, to mention factories where lead is produced, manipulated or used in its various forms; where dangerous metals — arsenic, antimony, chrome, mercury, etc. — are employed; tar-distilleries and places where derivatives of tar or petrol are produced; gas works; patent fuel works; zinc foundries; glass works; cement works; china and pottery works. In all these factories, not only should cloakrooms, lavatories and dining rooms be obligatory, but it should be made compulsory upon employers to provide shower-baths and upon the workpeople to make use of them. The latter will not be so difficult to deal with as one is often led to believe, judging from experience of coal mines where the most rebellious to commence with are now the most ardent advocates of these useful additions. At the present time shower-baths are only compulsory for coal mines, but in my opinion all underground workings of any importance should have them provided.

Our shower-bath installations are well known and they are being improved upon every day. The most up-to-date nearly all conform to one type, consisting of a spacious room in the center of the building, which serves as a dressing room and where the older clothes hooks have given place to metallic lockers for the full complement of the working personnel, the wings being fitted up with bath compartments, lined with enamelled bricks to facilitate cleansing. The rooms are well ventilated, well lighted and maintained at an even temperature of 18° to 20° C. during the most rigorous weather. The dressing rooms are now provided with tool-chests for the accommodation of articles too weighty to be hung up with safety.

Such are, to my mind, the installations most indispensable to modern industry. I should like to see their daily extension an established practice, and this because private enterprise realises that the well-being of the worker is not simply a social duty but an important factor in production.

Before concluding I should like to say a few words about hygienic installations in the homes of the workpeople themselves. The workman does not pass the whole of his existence in the factory or workshop. The most of his time is devoted to home life, and consequently this should be rendered as pleasant and healthy as possible. I have neither the ability nor the time to discuss the big question of housing the working classes; I simply desire to indicate certain hygienic conditions which require attention. The miserable tenements which we know so well must go. In their place ought to be and are being established, along wide avenues planted with trees with a full

complement of light and sun, groups of workmen's houses within their own little gardens, forming what are known as "garden cities." Why not provide in each of these houses, in place of the more than rudimentary fittings with which we are familiar, water closets of a sensible and hygienic type, a constant supply of potable water, and, as one often sees in quite modern English homes, hot-water systems, kept going by the ordinary kitchen fire, with bathrooms, provided at least with shower-baths, where each member of a family can in turn go through the daily cleansing process, so necessary to parents and children alike when the labors or games of the day are ended.

Should the cost of these individual installations be prohibitive, at the very least there should be provided for each garden city a well-equipped bathhouse sufficient for the use of all the inhabitants. Why not also establish in the same building a communal washhouse for the family linen, or at least a common scullery for housewives to do their own washing, thus removing from the living quarters, as is really necessary, the emanations from the soap-suds and dirty water which are so prejudicial to domestic hygiene? I should like to see in the center of these garden cities, side by side with the primary school, the housewifery school and any other desirable educational institution, a hall for social gatherings, conferences, concerts or cinemas, together with a library, for the purpose of occupying and giving charm to the leisure moments which the shortening of the working day will considerably augment and which it is desirable should be rendered fruitful. It is there also that we should find the child welfare center, so necessary to the development of the younger generation, and the dispensary hospital for the proper treatment of injuries and severe illnesses.

It is not, believe me, the kingdom of Utopia which I have been picturing. All these installations are in existence in France, notably at a number of large coal mines of the Nord and the Pas-de-Calais. Many of our mines of the Campine have put in hand or have already completed similar projects and other large works have set the same example. But in this domain there is yet much to accomplish and it is only combined effort and hearty goodwill that can produce for our workpeople in a renovated Belgium hygienic installations worthy of the epoch.

INDUSTRIAL TUBERCULOSIS AND THE CONTROL OF THE FACTORY DUST PROBLEM *

C.-E. A. WINSLOW, Dr.P.H.
Professor of Public Health, Yale School of Medicine, and Senior Sanitarian, U.S.P.H.S. (Reserve)

AND

LEONARD GREENBURG, C. E.
Assistant Sanitary Engineer, U.S.P.H.S. (Reserve)

PART II

Methods of Studying Dust Content of Air

In view of the serious effects produced by mineral dusts in the employments noted in Part I of this paper, it seems evident that the exact determination of the dust content of the atmosphere becomes a matter of considerable importance. We need such data, first of all, in order to estimate the extent of the hazard involved in various industrial processes and, second, to measure the efficiency of various protective devices which may be introduced for the mitigation of the dust hazard.

The technical difficulties involved in the problem of dust determination are of considerable complexity, and it is of primary importance to determine the size of dust particles which we desire to include in such examination. It seems clear that any useful method of examination must include particles ranging down to 1 micron in diameter. The studies of the South African Commission (9) (10) (11) indicate that particles even 12 microns in diameter are of negligible importance, since such particles are rarely present in the fibrotic lung. Methods which reveal only the very large particles present in the air are, therefore, of little value. To this class of dust-counting procedures we must relegate most of the attempts so far made in this country to collect dust particles by causing a current of air to impinge against a surface covered with glycerine or some other adhesive material.

The earlier procedures of this kind soon proved unsatisfactory, but a device of this type has again been advocated by Dr. E. Vernon Hill of the Chicago Department of Health (15). Dr. Hill's dust counter consists of an exhaust pump for producing the movement of the air and a small capsule or shield fixed at the end of the pump, carrying a cover-glass covered with adhesive material for catching and retaining the dust. Dr. Hill has tested the accuracy of this apparatus by setting up six or more capsules in succession in series and causing the air to impinge upon one plate after another in succession. From this test he concludes that the first plate takes out 62 per cent. of the dust present. It seems obvious, however, that the removal of a particle of a given size and weight by an apparatus of this kind will depend primarily upon the velocity with which the air current approaches the adhesive plate. Large and heavy particles will be thrown against the first plate. Small and light particles, the momentum of which is so slight that they are carried round the first plate, will be carried round any number of plates that may be placed in series, so that this method of controlling the accuracy of the results obtained is valueless. The actual counts obtained by Dr. Hill are so exceedingly low (from 500 to 1500 particles per cubic foot in clean outdoor air and

* Part I of this article appeared in the preceding issue of the Journal of Industrial Hygiene.

from 10,000 to 30,000 in ordinary schoolroom air) as to make it reasonably clear that his sampling device retains only a small fraction of the dust particles actually present.

On the other hand, it is possible in the estimation of atmospheric dust to err in the other direction, by including particles too small to be of any sanitary significance. The point in which we are interested as public health workers is the differentiation between the ordinary normal atmosphere and the air of dusty factory workrooms such as we know to be dangerous to health. This difference is sharply marked so far as the dust particles between 1 and 10 microns in diameter are concerned, but the difference between such normal and abnormal air is masked and lost when we include in our determination the particles of ultramicroscopic size which are present in vast numbers in all air. These very minute particles can be estimated by such optical devices as the koniscope and the dust counter introduced by Aitken. Macfadyen and Lunt (16), for example, report 9,000,000,000 dust particles per cubic foot in ordinary indoor air by the use of the Aitken dust counter. Such results as this tend only to mask the really significant differences in particles of small but appreciable size which distinguish the normal atmosphere from the air of a dusty grinding shop.

If these conclusions are correct, the desideratum is a method which will reveal with reasonable accuracy the number of dust particles of a diameter between 10 microns and 1 micron (about the lowest limit of clear microscopic visibility with the magnification used in our dust analyses). The weight of dust present is interesting but much less important than the number of dust particles, since one very large particle will be less injurious to the lung tissue than a number of smaller ones.

There are three methods in use at the present time which appear to meet these practical requirements—the Palmer water-spray apparatus, the Kotzé konimeter, and the Bill electrostatic method.

The Palmer apparatus (17) was devised after a careful study of the inaccurate sugar filter method, the Graham Rogers glycerinated plate (which was a precursor of the Hill dust counter), and various other earlier procedures. The air to be sampled is drawn through water in a shallow trap at such a rate as to break the water up into a fine shower of spray in a glass bulb above, and this spray retains the dust in the air and finally washes it down into the trap. After the completion of a run, the dust which has accumulated in the water may be estimated by direct microscopic enumeration of the number of particles in a Sedgwick-Rafter cell and by weighing the dust after filtration through a Gooch crucible. This procedure was recommended for ordinary routine use in the *Final Report of the Committee on Standard Methods for the Examination of Air* of the Laboratory Section of the American Public Health Association (18).

The Kotzé konimeter, devised by a member of the South African Miners' Phthisis Commission, is based on exactly the same principle as the Hill dust counter, but the diameter of the nozzle through which the air passes is very small and the air is drawn through this small opening by a piston rod moved with great rapidity by a brass spring, so that the velocity of the air impinging on the plate is sufficient to give a practically complete sample of even the minute particles of dust. The strength of the piston spring is sufficient to give a calculated velocity of air to the impinging nozzle of not less than 30 or more than 80 m. per second, and the slide for collecting the dust is coated with vaseline. This apparatus is described in detail in the final report of the South African Commission (11), and results obtained by its use have recently been presented by Inness (19).

The Kotzé konimeter seems to be an admirable piece of apparatus and it is most desirable that careful tests should be made of its value as compared with the Palmer sampler. The South African workers dismissed the Palmer apparatus from consideration under a misapprehension, stating that particles under 10 microns in diameter are ignored in the Palmer count, which is, of course, not the case.

The third procedure, which has recently been suggested for the determination of atmospheric dust, is the electrostatic precipitation method described by Bill (20). This apparatus is apparently the most accurate yet devised for the determination of dust particles of the sizes which are of chief sanitary significance. Very careful comparative studies by Dr. Bill showed that the counts obtained by the Palmer apparatus averaged about 62 per cent. of those derived by electrostatic precipitation. A still more recent study by Fieldner (21) gives an efficiency of 40 to 50 per cent. for the Palmer apparatus (only 30 per cent. when compared to the results obtained by optical examination with silica dust, and only 13 per cent. with tobacco smoke — which well illustrates the fallacy of the optical methods as criteria of dust particles of sanitary significance). Dr. Bill's electrostatic apparatus is certainly deserving of most thorough study, but in its present form it is too bulky for ordinary field work. Dr. Bill concludes that the Palmer procedure "represents the best method of dust collection for its purpose that we now have."

The Committee on Standard Methods for the Examination of Air of the Laboratory Section of the American Public Health Association in its Fourth (Supplementary) Report (22) arrives at the same conclusion in the following terms:

It seems evident to your committee that there are three distinct methods which may be used with reasonable success for the determination of the dust content of the air. Their special advantages and disadvantages appear to be as follows:

The Palmer water spray apparatus is fairly convenient and portable and permits the determination of the total weight of dust as well as the number of particles in a given sample. It yields however only about 60 per cent. of the total dust present in the air.

The Kotzé konimeter is even more convenient and portable than the Palmer water spray apparatus, but it is not possible by its use to determine the weight of dust as well as the number of particles present. Exact comparative data as to the proportion of dust obtained by these two methods are not at present available.

The Bill electrostatic method yields more accurate results than those obtained by the Palmer apparatus and could of course be used for determining counts as well as weights of dust. On the other hand the apparatus is not as yet in a form sufficiently convenient for ordinary field work.

With all the facts in mind we are inclined to recommend that the Palmer water spray apparatus be retained for the present as the standard method for the determination of the dust content of air. It seems probable that the failure to collect all the dust actually found to be present by the electrostatic method will not seriously affect the relative values obtained in different environments. Recent studies of actual atmospheric conditions in industrial plants (23) (24) (25) . . . have shown that the Palmer method yields clean cut and satisfactory results, high counts being obtained in shops which are dangerously dusty and low counts being uniformly obtainable by the application of recognised methods of dust removal.

If later studies should indicate that the Kotzé konimeter yields materially higher results than the Palmer water spray apparatus, or if the Bill electrostatic collector should be made portable and convenient for field work, one or the other of these two devices should be adopted; but for the present we believe it is wisest to retain the Palmer apparatus for ordinary sanitary use.

Variations in Dust Content of Air from Normal and Industrial Environments

In order to obtain a conception of the seriousness of the dust hazard in a given industry it is important to review the variations which exist in the normal atmosphere and in the air of various types of industrial establishments. In the present discussion

all the data considered have been obtained by the Palmer method — the only one extensively used in this country — so that all the results are fairly comparable.

The dust content of pure outdoor country air is fairly represented by the results which are summarized in Table 8. The number of dust particles in this and succeeding tables refers only to what Palmer has called "¼ standard unit particles" — particles of a diameter less than 10 microns and down to the limit of ready recognition under the microscope (1 micron or somewhat less). The number of larger particles present is always relatively very small.

November 26 was a rainy day and December 1 was a clear day following a rain thirty-six hours before, and these results may be taken to indicate about the minimum likely to be obtained in pure outdoor air.

TABLE 8. — DUST CONTENT OF PURE COUNTRY AIR, RACEBROOK COUNTRY CLUB, NEW HAVEN

Date	No. of Samples	Dust Particles per Cu. Ft.			Mg. of Dust per Cu. Ft.		
		Minimum	Maximum	Average	Minimum	Maximum	Average
November 21	3	43,800	59,600	50,300	0.0001	0.0053	0.0031
November 24	6	16,200	30,500	22,100	..		
November 26	5	5,200	8,500	7,100	..		..
December 1	4	5,700	12,200	9,300	....	..	....

To illustrate the results characteristic of the air of city streets and of occupied spaces indoors, free from any special dust hazard, we may cite the results in Table 9 from a paper by Palmer, Coleman, and Ward (26). It is interesting to note that of the three samples collected outside the Woolworth Building one from the street level showed 118,000 particles per cubic foot, one from a window on the tenth floor, 72,000, and one from a window on the fifty-eighth floor, 23,000.

Finally, in Table 10 we have collected a considerable series of determinations of the average dust content of the air in various types of industrial establishments from our own results, from those of Palmer, Coleman and Ward, to which reference has just been made, and from a paper by Miller and Smyth (23). The figures are arranged in ascending order according to the number of dust particles present.

The results presented in Table 10 illustrate well the range in dust counts to be expected under practical conditions — from values between 100,000 and 200,000 dust particles per cubic foot in factories where the dust problem is well cared for to figures one hundred or even one thousand

TABLE 9. — DUST CONTENT OF AIR OF CITY STREETS AND OCCUPIED SPACES WHERE NO SPECIAL DUST HAZARD EXISTS

Source of Samples	No. of Samples	Dust Particles per Cu. Ft.			Mg. of Dust per Cu. Ft.		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Outside balcony, city college	3	125,000	199,000	153,000	0.0000	0.0037	0.0012
Outside Woolworth Building	3	23,000	118,000	72,000	0.0048	0.0310	0.0150
Business office	2	128,000	172,000	150,000	0.0056	0.0125	0.0090
Department store	4	94,000	118,000	108,000	0.0056	0.0278	0.0153

times as great in the worst types of grinding shops and abrasive factories. The character of the dust present must, of course, be taken into account in considering the sanitary significance of these figures, large counts in such places as the cement mill and the mattress renovating factory being of relatively slight harmful possibilities. The enormous weight of the dust found in the air of the sand-blast chamber is, of course, due to the presence of large fragments of the sand used in the process. It is, however, somewhat surprising to note that, in spite of the presence of this great

TABLE 10.—DETERMINATIONS OF AVERAGE DUST CONTENT OF AIR IN VARIOUS TYPES OF INDUSTRIAL ESTABLISHMENTS

Source of Samples	Observer	No. of Samples	Average Dust Particles per Cu. Ft.	Average Mg. of Dust per Cu. Ft.
Cigar shop	Miller and Smyth	19	103,000	0.0840
Good pearl button factory	Palmer, Coleman and Ward	5	106,000	0.0001
Blanket plush and carpet	Miller and Smyth	13	149,000	0.5040
Good dry grinding shop	Winslow and Greenburg	10	154,000	0.0548
Pottery	Miller and Smyth	5	183,000	0.1300
Good light polishing shop	Winslow, Greenburg and Angermyer	8	195,000	0.0181
Good heavy polishing shop	Winslow, Greenburg and Angermyer	7	204,000	0.0300
Rag sorting	Palmer, Coleman and Ward	5	337,000	0.1352
Feather drying (with starch)	Palmer, Coleman and Ward	5	484,000	2.6000
Steel grinding	Miller and Smyth	3	490,000	0.4330
Asbestos	Miller and Smyth	6	494,000	0.3540
Fur hat factory	Palmer, Coleman and Ward	5	599,000	0.1025
Marble cutting	Palmer, Coleman and Ward	4	648,000	0.0607
Flint mill	Miller and Smyth	3	844,000	0.4590
Iron grinding	Palmer, Coleman and Ward	4	2,086,000	0.1297
Mattress renovating	Palmer, Coleman and Ward	5	3,750,000	0.3613
Cement mill	Miller and Smyth	11	6,791,000	2.1850
Axe grinding shop	Winslow and Greenburg	32	15,800,000	0.4140
Abrasive factory B	Winslow, Greenburg and Greenberg	57	31,010,000	1.7430
Sand-blast chamber	Winslow, Greenburg and Reeves	10	60,880,000	55.2900
Abrasive factory C	Winslow, Greenburg and Greenberg	9	159,779,000	7.8050

obviously of much less moment than lower values in the mineral industries.

It is interesting to notice from this table the comparatively slight significance of the determination of the weight of the dust present which is so markedly influenced by the presence of a comparatively few large particles. Thus, the feather drying factory showed the third largest dust content in the table by weight, as a result of the presence of the starch used in the treatment of the feathers — an aerial contamination which has presumably no harmful influence upon the health of the workers. The fourth highest weight in the table is exhibited by the cement mill which again involves a dust quantity of dust as shown by weight, the actual number of small particles present is less than in the air of one of the abrasive factories studied — air which to the senses would appear infinitely purer than that of the sand-blast cabinet. The abrasive factory in question apparently represents the worst condition from the standpoint of industrial dust that has yet been reported (25).

Control of Dust Hazard by Substitution of Wet for Dry Processes

Having reviewed the relation between industrial dusts and tuberculosis and the

extent of the dust hazard in various industries, it remains to consider the measures which may be taken to control this danger and the success which they have attained, as measured by determinations of the actual dust content of the air.

There are, in general, four different methods of protecting the worker against the influences of industrial dusts, which may be classified as follows: the substitution of wet processes for dry processes; the conduct of dust-producing operations in enclosed chambers; the removal of dust by hoods equipped with exhaust draft; and the use of respirators and helmets.

The most successful example of the use of moisture for decreasing the danger from atmospheric dust is perhaps to be found in the measures taken to protect the worker in the South African metal mines. Table 11, for example, from the 1916 report of the Miners' Phthisis Prevention Committee (with weights changed from milligrams per cubic meter to milligrams per cubic foot) shows the effect upon the composition of the air at the top of the upcast shaft of a mine of the application of a general system of underground spraying.

In many other industrial processes the use of water is highly effective in the control of dangerous dusts, as in the wet grinding of white lead, and the analogous process of rubbing down lead paint with pumice and oil instead of sandpaper. We must be on guard, however, against the assumption that a process is necessarily free from dust because water is used in connection with it.

This fact was forcibly borne in upon us by the study of the conditions in the Connecticut axe factory which have been discussed in Part I of this paper. The predominant process in this factory was wet grinding, and the few dry grinding shops in operation were in excellent condition as will be pointed out further on. The enormous tuberculosis mortality of 1900 per 100,000 among the polishers and grinders in this plant must, therefore, be due to dust produced in the process of wet grinding, which the standard texts on industrial hygiene generally assume to be harmless — an assumption which was also entertained by the officials of the axe factory in question.

Our study of the actual conditions soon indicated that the confidence in wet grinding was wholly illusory. The grinding wheels at this plant were of natural sandstone, so friable that a stone originally 72 inches in diameter, when used to grind axes, is reduced to a diameter of 29 inches (at which point it is discarded) in about one month. A stream of water from a 1-inch pipe is continuously discharged upon the wheel but the amount of this water is regulated by the worker and is kept down to a small amount to avoid splashing and to facilitate rapid work. The operators bear down very heavily upon the wheel in grinding and the net result, as indicated in Table 12, is the generation of enormous quantities of dust.

TABLE 11.—DUST CONTENT OF AIR OF SOUTH AFRICAN MINE IN MILLIGRAMS PER CUBIC FOOT

Hour	Sept., 1911 No Sprays	April, 1912 Sprays in Use	Sept., 1912 Additional Sprays in Use
9 A.M.–10 A.M.	7.9	0.9	0.10
11.30 A.M.–12.30 P.M.	3.7	0.6	0.06
2 P.M.–3 P.M.	2.3	1.1	0.60
4.15 P.M.–5.15 P.M.	2.8	0.4	0.50

It appears evident, then, that while the use of moisture is sometimes successful in controlling the dust hazard, this procedure may or may not be effective, depending on the details of the process and the method by which the water is applied. The only way to determine its efficacy in a given case is by a study of the actual dust content of the air.

Control of Dust Hazard by Conduct of Dust-Producing Operations in Enclosed Chambers

A second method of controlling the dust hazard consists in the carrying out of dust-producing processes, such as sifting, crushing, tumbling, and the like, by mechanical devices in enclosed chambers. In dealing with poisonous dusts, like that which is encountered in white lead manufacture, this type of device has proved notably successful.

Here again, however, as in the case of the application of moisture, the efficiency of the particular installation depends on the care with which the details of design and operation have been carried out. In Table 13 are summarized the results of our examinations of the air of two workrooms in which tumbling barrels were used, one installation being effective and the other quite inadequate. The first process was inherently less dusty than the second, consisting of the polishing of metal pieces in sawdust, and the tumbling barrels were well constructed and tightly closed. The second process involved the removal of scale from castings and, although conducted in supposedly closed barrels and provided with an exhaust, the barrels and the exhaust system were in such poor repair that the air of the workroom was exceedingly dusty. From these results, then, it is once more evident that the real efficiency of a given device for controlling the dust hazard can only be determined by actual examination of the air of the workroom.

Control of Dust Hazard by Operation of Hoods and Local Exhaust Ventilation

There will always remain many industrial processes, such as certain types of grinding and polishing, which cannot be carried on by wet methods or in enclosed chambers. The most obvious, and the most generally satisfactory method to be used for the protection of the worker in such cases is the provision of properly designed hoods equipped with a system of exhaust ventilation sufficiently powerful to remove the dust as it is produced and to carry it away from the workroom.

The excellent results which may be obtained from the use of a system of this kind are well illustrated by the analytical data for the dry grinding shop and the two polishing shops included in Table 10 and more fully presented, with minimum and maximum figures, in Table 14. It is of interest to notice that the dry grinding shop in question was situated in the same Connecticut axe factory which furnished the wet grinding results summarized in Table 12. The management in this plant was somewhat concerned about a possible health hazard in its dry grinding department but assumed that its wet grinders were in no danger; whereas the exhaust system in operation kept the air of the dry grinding shop in excellent condition and the wet grinding shop was, as a matter of fact, exceedingly dusty.

The chief conditions essential to the success of an exhaust system for the removal of dust from grinding and polishing wheels are four in number: the design of the hoods themselves so that the point where the dust is generated may be covered as completely as possible without interfering with the work, and as closely as possible so that a full suction velocity may be maintained; the arrangement of the suction draft so that it may operate with and not against the centrifugal force which throws the dust particles from the wheel; the elimination of all obstacles between the hood and the main exhaust duct which may decrease the velocity of suction; and the maintenance of an adequate suction head in the main exhaust duct itself.

TABLE 12. — DUST CONTENT OF AIR IN WET GRINDING SHOPS OF AN AXE FACTORY

No. of Samples	Dust Particles per Cu. Ft.			Mg. of Dust per Cu. Ft.		
	Minimum	Maximum	Average	Minimum	Maximum	Average
32	870,000[1]	50,000,000	15,800,000	0.0790	2.1600	0.4140

[1] This was the only sample below a million. The next lowest count was 1,900,000.

TABLE 13. — CONTRAST BETWEEN DUST CONTENT OF AIR IN A GOOD AND A BAD TUMBLING ROOM

Room	Condition of Tumbling Barrels and Exhaust	No. of Samples	Dust Particles per Cu. Ft.			Mg. of Dust per Cu. Ft.		
			Minimum	Maximum	Average	Minimum	Maximum	Average
A	Good..........	2	102,000	261,000	181,000	0.0177	0.0517	0.0347
B	Bad...........	6	2,940,000	11,400,000	6,250,000	0.0760	2.7800	0.9212

TABLE 14. — DUST CONTENT OF AIR IN GRINDING AND POLISHING SHOPS EQUIPPED WITH EFFICIENT HOODS AND EXHAUST SYSTEMS

Type of Workroom	No. of Samples	Particles of Dust per Cu. Ft.			Mg. of Dust per Cu. Ft		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Dry grinding shop — axe factory. . .	10	51,500	400,000	154,000	0.0190	0.1010	0.0548
Cornering and light polishing shop — small-arms factory..............	8	22,000	720,000	195,000	0.0098	0.0422	0.0181
Heavy polishing shop — small-arms factory........................	7	52,200	854,000	204,000	0.0099	0.0672	0.0300

TABLE 15. — COMPARATIVE STUDY OF NUMBER OF DUST PARTICLES AND WEIGHT OF DUST IN AIR WITH HIGH AND LOW SUCTION HEADS

Sample No.	U-Tube Reading in Inches	Number of ¼ Standard Unit Particles per Cu. Ft. of Air	Mg. of Solids per Cu. Ft.	Sample No.	U-Tube Reading in inches	Number of ¼ Standard Unit Particles per Cu. Ft. of Air	Mg. of Solids per Cu. Ft.
6211	3.75	215,000	0.0295	6212	0.50	535,000	0.0292
6241	3.50	22,400	0.0105	6242	0.25	1,773,000	0.0605
6243	2.75	45,200	0.0098	6244	1.25	894,000	0.0275
6251 [1]	4.63	22,200	0.0085	6252 [1]	0.25	48,300	0.0156
6253	3.56	241,000	0.0104	6254	0.50	745,000	0.0193
6261	2.62	720,000	0.0193	6262	1.25	1,000,000	0.0422
6263	3.25	44,500	0.0148	6264	0.25	654,000	0.0293
6271	3.00	252,000	0.0422	6272	0.25	790,000	0.3620
7161	3.50	854,000	0.0672	7162	1.50	1,418,000	0.0382
7163 [2]	3.00	70,000	0.0153	7164 [2]	0.63	42,900	0.0106
7165	2.88	56,800	0.0130	7166	0.63	2,980,000	0.2120
7171	2.63	87,000	0.0553	7172	0.50	191,000	0.0102
7181	3.25	130,700	0.0099	7182	0.50	165,000	0.0270
7191	3.50	180,500	0.0240	7192	....	1,075,000	0.0748
7193	2.38	52,200	0.0254	7194	0.13	638,000	0.0802

[1] Operator worked only ten minutes. [2] Very light operation.

Glaring defects in construction in all these respects are unfortunately only too common. Everyone who has examined exhaust systems, as actually installed, is familiar with the hoods designed by workmen unacquainted with the first principles of ventilation practice. Hoods may be observed which are so small and so badly placed that even the eye can note the stream of sparks missing their mouths by inches. Even when the hood is adequate in itself an exhaust duct connected at the rear of the hood, where the dust is being thrown off toward the top or the bottom of the wheel, will fall far short of its potential efficiency. The exhaust ducts themselves are often designed in violation of every law of physics. In another part of the same small-arms plant, in which are installed the excellent systems discussed above, is another exhaust system for a set of forge grinding wheels, the last section of which is a 6-inch pipe (28 square inches in cross-sectional area) into which four 5-inch pipes (combined cross-sectional area, 78 square inches) discharge. It is small wonder that the suction velocity in the last branch was found to be zero and that the dust content of the air of the workroom averaged 353,000 dust particles per cubic foot. Even in the well-arranged cornering and light polishing shop there were individual machines at which clogged wire mesh screens placed in the throat of the duct below the wheel reduced the velocity of the exhaust current from 900 to 500 feet per minute.

The strength of the exhaust draft maintained in the exhaust system is, of course, one of the chief factors in determining the efficiency of an installation of this kind. This is measured by drilling a small hole in the suction pipe and applying to this hole the end of a rubber tube connected to a glass U-tube containing a colored aqueous solution and backed with a scale on which can be read the difference in the level of the two arms of the U-tube produced by the negative head in the suction pipe.

A special study of the relation between suction head in the exhaust system and the dust content of the air of the workroom was conducted by us a year or more ago in the polishing shops of the small-arms plant, the normal conditions in which are indicated in Table 14 (24). Observations were made in pairs — first, under the normal conditions of operation of the exhaust system, and then, at the same point, after an interval of five or ten minutes, during which the suction head had been reduced by opening doors in the main exhaust duct between the point of examination and the exhaust fan. The results of this study are presented in Table 15.

It is evident that in general, other conditions being equal, a reduction in suction head is quickly followed by an increase in air dustiness. The dust counts with low exhaust pressure are relatively high, varying, with two exceptions, from 165,000 to 2,980,000 particles per cubic foot of air. It will be noted that while collecting sample 6252 the operator worked only ten minutes of the sampling time, and in the case of sample 7164 the operation was very light. The average of all the dust counts is 863,000 particles.

With the application of the normal, higher exhaust pressure the dust content is considerably lower, an average of all the samples being 200,000 particles. In this case there are again two samples, 6261 and 7161, which greatly increase the value of the average.

The average weight of solids per cubic foot of air is 0.069 milligram with the low exhaust pressure (averaging 0.56 inch), and 0.023 milligram with the high exhaust pressure (averaging 3.21 inches).

An examination of the corresponding observations in the two halves of Table 15 (the normal conditions being on the left, the reduced exhaust velocities on the right)

shows more clearly than the general averages just what was happening. In one case (samples 7163 and 7164) where only a very light operation was going on, the reduction of the suction head from 3 to 0.63 inches had no effect on the dust content. In every other instance the dust count went up when the suction was reduced, sometimes only a little — from 720,000 to 1,000,000 (6261–6262), or from 854,000 to 1,418,000 (7161–7162), or from 130,700 to 165,000 (7181–7182)—but usually very markedly. In five instances the count of dust particles increased more than tenfold — from 22,400 to 1,773,000 (6241–6242); from 45,200 to 894,000 (6243–6244); from 44,500 to 654,000 (6263–6264); from 56,800 to 2,980,000 (7165–7166); and from 52,200 to 638,000 (7193–7194). When all the results were plotted and a representative curve obtained, it appeared that in the two polishing shops in question a count of 700,000 dust particles or more was likely to be found with a suction head of 1 inch or less, while a count of about 500,000 corresponded to a 2-inch head, and a count of about 250,000 to a 3-inch head. Obviously such a relation will only hold in quantitative form for the particular type of polishing and the particular type of exhaust system which were studied in this individual case.

Control of Dust Hazard by Wearing of Respirators and Helmets

Finally, in certain industrial processes, as in packing operations, in marble and granite working, and in the sand-blasting of large castings, it is impossible by any of the means previously described to keep the air of the workplace free from dangerous concentrations of mineral and metallic (or poisonous) dusts. In such cases as this, the only alternative is the wearing of respirators which filter out the dust particles from the air before it is drawn into the respiratory tract, or of helmets which exclude the dusty atmosphere more or less completely from the mouth and nose and supply pure air for breathing from some other source. All such devices are uncomfortable and irksome to the wearer and the necessity for using them should be avoided wherever possible by the installation of the other devices which have been considered above. In certain employments, however, the respirator or helmet offers the only possible means of protection.

It is important, therefore, to determine the actual efficiency of the various types of respirators and helmets which are available, and such studies must be made with the particular dust and under the particular conditions with which it is desired to deal in practice. The Division of Industrial Hygiene of the New York State Department of Labor in a recent bulletin (27) has given a broad and sweeping endorsement to a respirator composed of one-half ounce of clean absorbent cotton in a layer 5 inches wide, 6 inches long, $\frac{3}{4}$ inch thick, pinned to a piece of cheese-cloth and tied over the nose and mouth. The bulletin states that dust-laden air containing a basic lead salt showed no trace of lead after passage through this layer of cotton. Nothing is said about the fineness of division of the lead dust, however, and it is questionable whether really fine dust could be effectively retained by such a device.

The most extensive previous studies of this subject which have come to our attention were made in the Hygienic Institute of the University of Berlin and are to be found in the Zeitschrift für Hygiene (28) (29). In the first of these papers Kobrak describes a special form of mask designed especially for protection against infections, droplets, and dust, and in the second paper Schablowski reports an extensive series of studies on the efficiency of various types of respirators used for protection against industrial dusts. Both observers used bac-

terial spores as a measure of the purifying effect executed by the devices studied. In Schablowski's experiments the various industrial dusts (cotton, cement, basic slag and rouge) were intimately mixed with a suspension of spores, redried, and blown into the air of an experimental chamber. A person equipped with one of the protective devices under examination, and a control individual with no such protection, entered the chamber, the noses of both being plugged with sterile cotton in amount sufficient to filter out the dust contained in the air without interfering too seriously with respiration. At the close of the experiment the cotton was washed in sterile water, gelatin plates were made, and the percentage removal of bacterial spores determined by comparing the count from the cotton in the nose of the unprotected individual with that in the nose of the individual wearing the mask or respirator. It was assumed that the removal of bacterial spores would correspond with the removal of the dust particles with which they were mingled. In a few cases control studies were made by direct chemical determinations of the amount of rouge collected by the cotton filters in the nose.

A large number of different types of respirators and helmets were studied by Schablowski, using the methods outlined above. The removal effected varied from 11 to 89 per cent., the latter result being attained by the use of the Kobrak mask with *Moellertuch* as a filtering material. The method used in these studies is ingenious, but the opportunities for experimental errors in the bacteriological technique involved are very considerable, and the assumption that the efficiency of dust removal will vary with the removal of bacterial spores mixed with the dust is a somewhat doubtful one.

A more recent study of the efficiency of respirators is reported by the Miners' Phthisis Prevention Committee of South Africa in its General Report issued in 1916 (10). Nine types of respirators were studied, a sugar filter being used to determine the respective dust content of normal mine air and of similar air passed through the respirators. Before blasting, the mine air contained from 0.028 to 0.28 mg. of dust per cubic foot, and the same air after passing the various respirators contained from 0.014 to 0.037 mg. The removal effected by the various types of respirators varied between 30 and 88 per cent. After blasting, the mine air contained from 1.16 to 1.78 mg. of dust per cubic meter and after passing through the respirators it contained from 0.368 to 1.78 mg. The removal effected varied from 0 to 77 per cent. The results obtained before and after blasting with the same respirator varied widely. For example, one type of respirator effected a 75 per cent. removal before blasting and produced no reduction at all after blasting. In view of these wide differences it seems probable that local variations in the dust content of the mine air must have been considerable.

It has seemed to us important to accumulate more accurate data in regard to the quantitative efficiency of various types of respirators and helmets in actual use in the United States and last year the opportunity was offered to conduct a study of this kind under unusually favorable conditions (30). Our observations were made in a sand-blast cabinet used for the sand-blasting of castings and forgings in an automobile plant, and this represented one of the most extremely dusty environments to be met with in any industry. The sand-blast operators in this plant were provided with respirators of the ordinary "muzzle" type with a rubber body fitting over mouth and nose, an air filter composed of two layers of muslin having about 75 meshes to the inch, and a piece of sponge about 2½ by 3 by 1 inch, and fitted with an air outlet valve. They were also supplied with hel-

mets made of cloth-covered cardboard, provided in front with a 3 by $4\frac{1}{2}$-inch window of 40-mesh wire gauze, through which the operator could see the work, and provided also with an inlet tube on top for fresh-air supply. The helmet was fitted with a string by means of which the apron or lower portion could be drawn tightly around the neck, thus making a fairly airtight covering with the exception of the wire gauze-covered portion in front.

In using these protective devices the operator as a rule first placed a handkerchief over his nose and mouth, tying it in a knot at the back of his head, then placed the respirator in position, and finally put on the helmet. The workers prior to our investigation did not make use of the air inlet at the top of the helmet, intended to be connected with a fresh-air supply line, for the reason that the fresh-air supply as drawn from the general supply air compressor was contaminated with oil, which produced a very disagreeable odor when blown into the helmet in large quantities. Furthermore, it was difficult by means of the valves as installed to control the quantity of air supplied to the helmet; and, lastly, the fresh-air line entered the cabinet at one side, so that the length of unsupported hose necessary when working in the center of the chamber created an uncomfortable drag on the worker's head.

For collecting the dust samples we used the Palmer water-spray apparatus. The sampler was set up on a table in the sand-blast cabinet at about the height of the worker's head, while work was in progress as usual. The apparatus was protected against the direct blast of the sand by a covering of heavy wrapping paper. To the air inlet was attached a sampling tube 1 inch in diameter and 17 inches long, terminating in a funnel-shaped opening 3 inches in diameter. With the funnel open we obtained samples of the normal air of the cabinet, and with the respirator held in position over the end of the funnel by means of rubber bands we determined the filtering effect of this device. In testing the efficacy of the helmet the funnel, with or without the respirator, could be placed inside the helmet, which was supported on a specially constructed wire frame. The general results of this investigation are presented in Table 16.

TABLE 16.—EFFICIENCY OF RESPIRATOR AND HELMET IN REDUCING DUST CONTENT OF AIR OF A SAND-BLAST CABINET

Source of Samples	No. of Samples	Number of Dust Particles per Cu. Ft.			Mg. of Dust per Cu. Ft.		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Untreated air of cabinet	10	15,000,000	82,000,000	60,880,000	12.43	119.80	55.29
Air passed through respirator alone	8	1,370,000	7,070,000	4,549,000	0.19	2.86	1.26
Air passed through helmet-respirator	19	369,000	4,480,000	2,047,000	0.03	1.46	0.24
Air passed through helmet with positive air supply	10	118,000	1,529,000	368,000	0.01	0.08	0.04
Air passed through helmet with positive air supply and respirator	22	18,000	329,000	156,000	0.01	0.09	0.03

In the particular series of tests in which the respirator alone was used the average dust content of the normal air of the cabinet averaged 49,400,000 particles per cubic foot and the air which had passed through the respirator, only 4,549,000. These results were somewhat more favorable than those which could be expected in practice, since the respirator fitted our sampling funnel more closely than it would be likely to fit the face of a worker.

From the standpoint of the actual dust

content of the air which would be respired by a sand-blaster, the use of the respirator alone evidently fails to provide an adequate protection. The dust content of the air after passing the respirator (varying from one to seven million, and averaging 4,549,-000 particles per cubic foot) was still excessively high. From the standpoint of per cent. removal, on the other hand, the respirator showed a high efficiency which should make it a fairly satisfactory protective device for use in a workplace where the initial dust content was not so enormously high. The respirator studied by us removed about 92 per cent. of the dust present by count, and 97 per cent. by weight. The results on a basis of number of dust particles compared with the best of those obtained by Schablowski, and the results by weight are much better than those reported by the South African Commission. The conditions are not comparable, however, in view of the different dusts with which the respirators had to deal in the two cases. The dust content of the air of the South African mines, even after blasting, was only from 1.2 to 1.8 mg. per cubic foot as against 12.4 to 27.2 mg. in our case. The larger the amount of dust present in the air (and the larger the individual particles), the greater will be the per cent. purification. Weight determinations are in any case of little value since the larger particles — those of least sanitary significance — will be the ones most readily removed by any filtering device. The South African study includes only weights, but it is the count of small (one-fourth standard unit) particles which is really significant.

The use of the helmet and respirator in combination, but without a positive air supply to the interior of the helmet, produced a reduction from an average of 58,-330,000 dust particles per cubic foot of air to an average of 2,355,000 — a reduction of 96 per cent. These results are, of course, distinctly better than those obtained with the respirator alone, but the air was still too dusty to be respired with safety. Evidently the use of positive air pressure within the helmet was essential in this exceedingly hazardous occupation.

In conducting the tests with positive air pressure the sampling tube, with respirator in place, was set inside the helmet and to the $\frac{1}{4}$-inch inlet at the top of the helmet was attached an air line delivering air through a flow meter. Since the Palmer apparatus, during the period of sampling, was removing air from the interior of the helmet at a rate of 2 cubic feet per minute, it was necessary to supply air in excess of this amount in order to preserve a condition of positive pressure within the helmet. We therefore adjusted the valve on the air line so that the amount of air actually delivered to the helmet was in the neighborhood of 3 cubic feet per minute (ranging from 2.3 to 3.7 cubic feet per minute). The results of nineteen such observations on five different occasions showed that the dust content of the air collected in this way, with an average air supply of 2.9 cubic feet per minute to the interior of the helmet, ranged from 18,000 to 329,000 one-fourth standard unit particles and averaged only 151,000 such particles per cubic foot.

These results were so encouraging, and indicated so clearly the value of positive air pressure in excluding dust, that it seemed of interest to determine the efficiency of the helmet alone, provided with positive air pressure but without the use of the respirator. We therefore set the apparatus up as before but without the respirator and, on two different occasions, collected the dust from ten samples of air in this way, with three control samples in which the respirator was present. The air supply to the interior of the helmet was about the same as before, ranging from 2.4 cubic feet to 3.1 cubic feet and averaging 2.7 cubic feet per minute. The results of this study were not quite so good as those obtained

with the use of the respirator, but the difference was comparatively slight. The dust counts without the respirator ranged from 118,000 to 355,000, except for one count of 1,529,000, and the average, including this aberrant count was 368,000 particles per cubic foot. If the one exceptional count were excluded, the average for the group would be only 239,000 particles per cubic foot. The weights obtained in this way without the respirator ranged from 0.01 to 0.08 mg. per cubic foot and averaged 0.04 mg. per cubic foot.

These results appear to us to be of considerable general interest as indicating the possibility of excluding dust from the respiratory tract of the worker by maintaining a positive air pressure in a comparatively impermeable inclosure about the head, rather than by attempting to filter the incoming air through a close-grain respirator. In processes where the workman must move about over a wide area such a method of protection would not be feasible, but in the sand-blasting cabinet it is altogether practical to use positive air pressure.

In regard to the amount of air to be supplied to the helmet in practice, it should be noted that we used, on the average, somewhat less than 3 cubic feet per minute, while the Palmer apparatus was constantly removing 2 cubic feet per minute. In other words, the pressure at the front window of the helmet was produced by an excess of air supply over the air exhaust through the Palmer apparatus of less than 1 cubic foot per minute. In practice it would be necessary to maintain a corresponding excess of air supply over the amount withdrawn from the helmet during inspiration. Assuming that for the type of physical effort required in sand-blasting each inspiration removes 90 cubic inches of air in a period of 1.5 seconds, the draft upon the air in the helmet, during the inspiration period, would be at the rate of approximately 2 cubic feet per minute. A gross air supply to the helmet of 2.5 to 3 cubic feet per minute should, therefore, prove ample to maintain satisfactory conditions in practice.

The solution of the odor problem (which, as noted above, has proved troublesome in the plant where our studies were made) has proved comparatively simple. We found that only when large quantities of air were allowed to enter the helmet was the odor of oil noticeable. With the air supply to the helmet reduced to 3 cubic feet per minute, we were ourselves unable to detect any odor in the air supplied. If trouble of this kind should be experienced, there are on the market simple and inexpensive air filters which may be placed in the air line to remove any impurities present. The use for the fresh-air supply of a small impeller type blower which does not use lubricating oil internally would, of course, solve this difficulty completely.

It is evident from these studies that both respirators which filter the incoming air and helmets which exclude the dusty atmosphere by an interior positive air pressure may be highly efficient under certain conditions in protecting the worker against the hazards of industrial dusts. Whether such devices are actually adequate in a given case can only be determined by actual tests such as those which have just been described.

Importance of Definite Analytical Standards in Control of Industrial Dust Hazards

If real progress is to be made in the control of the industrial dust hazard, it is important that standards of a reasonably definite nature should be established by which the adequacy of protective devices can be judged in any given case. For the most part, such standards have been completely lacking in the past. There are many state laws which deal with this problem but, as a rule, only in terms so general

as to be of no practical value. It is not particularly helpful to provide that dusts shall be removed "as far as practicable" or "as far as the nature of the business permits" or "when inhaled to an injurious extent," if the inspector charged with the enforcement of the law has no way of judging how dusty the air of a given workroom is or how far its dust content could be practically reduced.

In connection with exhaust systems for grinding and polishing shops, several industrial codes contain more specific regulations, dealing almost exclusively, however, with the mechanical details of construction and with the minimum static head to be maintained in the exhaust ducts. Thus, according to the Wisconsin code:

> On all grinding, buffing, and polishing wheels, the suction in the connection to the hood must be sufficient to displace a column of water in a U tube, 5 inches.
>
> The test for suction with the U tube must be a static test and must be made in the following manner: A hole ⅛ inch in diameter must be made in the suction pipe approximately 12 inches from the connection to the hood. The rubber hose attached to the U tube must be placed over the ⅛-inch hole and the test made under these conditions. When the water in the U tube stands at 0, the 5-inch displacement is secured when one column of water rises 2½ inches above 0 and the other column of water falls 2½ inches below 0.

The New Jersey code requires that:

> Sufficient suction head shall be maintained in each branch pipe within 15 inches of the hood to displace 2 inches of water in a U-shaped tube. Pressure to be taken by pressing tube attachment over small opening through pipe, commonly called static method. Tests to be made with all branches open and unobstructed.

The New York code reads:

> Sufficient static suction shall be maintained in every branch pipe within 1 foot of the hood to produce a difference of level of at least 2 inches of water between the two sides of a U-shaped tube. Test shall be made placing one end of a rubber tube over a small hole made in the pipe, the other end of tube being connected to one side of U-shaped water gauge. Such test shall be made with all branch pipes open and unobstructed.

The head, as thus measured, includes both velocity and frictional components, and it is obvious that it bears no necessary relation to the velocity of the exhaust at the face of the wheel itself. The state codes, to which reference has been made, do, it is true, specify the size of the exhaust piping to be installed for a wheel of any given size, but the form of the hood and its arrangement in relation to the grinding process will materially affect the results obtained, while any obstruction to air flow between the wheel and the point where the suction head is measured will reduce the actual efficiency obtained with a given suction head.

For such reasons the standard which depends only on suction head in the exhaust pipe seems to us inadequate as a measure of the actual protection afforded to the workers, and the difference between the New York and New Jersey standards of 2 inches and the Wisconsin standard of 5 inches indicates that the evidence upon which even this imperfect standard has been based must be somewhat inconclusive.

A more valuable sort of standard from the sanitary standpoint would be one based on actual velocity of exhaust at the point of dust production, instead of suction head in the duct below. Such a standard was suggested by the British departmental committee on the lead hazard in the pottery industry (6) in the form of the very mild recommendation that a speed of 100 linear feet per minute should be maintained at the point of dust production.

The only standard that can be altogether satisfactory to the sanitarian, however, is one that deals directly with the actual condition of the air inhaled by the worker. It is well that certain definite suction heads and air velocities should be maintained, but what we really want to know is whether the dust has actually been removed. Mechanical standards are con-

venient and easy of application, but it is the actual state of the atmosphere that is of primary importance. What we must ultimately rely upon in the future is a standard that rests upon the number of dust particles actually contained in the air breathed by the worker.

So far as we are aware only three efforts have so far been made to set definite standards of this kind for industrial dusts. The earliest of these attempts was made by the Miners' Phthisis Prevention Committee of South Africa, reference to whose report (10, p. 21) shows that they were fully cognizant of the difficulty and the novelty of the problem. To quote:

69. The committee, being desirous of taking immediate steps to cope with the disease, was confronted with the difficulty that no standard of purity with regard to dust existed to which to work. In order to assist in arriving at such a standard, tests of the amount and the character of the dust in the street air of Johannesburg were taken, as affording some basis of comparison. At the same time, it was soon discovered by experiment that it was practically impossible to remove by dust allaying devices all the dust from either underground or surface air. The question arose as to what weight per cubic meter could be considered permissible, and as this was more or less a matter for conjecture the committee decided, for the time being, to adopt the tentative standard of 5 mg. of dust to the cubic meter of air. This figure was at the time supposed to represent the average amount of siliceous dust under 70 microns diameter present in the air of a Johannesburg street, but on account of the great difference in character and the proportion of "injurious" dust between mine and street dust, the direct comparison of weights may be misleading.

The amount of "injurious" dust which air can carry without being dangerous has not yet been determined, and indeed can only be ascertained by experience.

Another attempt to set a standard for the dust content of air was made by Higgins, Lanza, Laney, and Rice (8) in their very complete study of the mines in the Joplin district, Missouri. They say:

The most reasonable standard then appears to be one based on the quantity of dust that will remain in suspension after the best known methods have been put into use for its abatement.

It has been demonstrated in the sheet ground mines of the Joplin district that by the proper use of water and the regulation of certain details of mining the quantity of dust in the mine air can be kept below 1 milligram per 100 liters of air; so it seems reasonable to use 1 milligram as a standard at least for the Joplin district.

In an earlier paper (24) we have attempted to formulate practicable standards for estimating the adequacy of exhaust systems installed in grinding and polishing shops, based on our own studies of well-equipped systems of this type, in accord with the principle laid down some years ago by the Massachusetts State Board of Health that in fixing standards of industrial hygiene it was reasonable to require that conditions should be maintained in any industry approximately equal to those already found in the best plants of that industry in actual operation.

In the best installations of this kind that we have studied we find the suction head in the exhaust pipes varying between 2 and 5 inches and averaging somewhat over 3 inches. A fall to 1.25 or 1.50 inches, when the exhaust was reduced for experimental purposes, was at once followed by a marked increase in air dustiness. It would appear from these observations that the 5-inch suction head called for by the Wisconsin code is unnecessarily severe, while the 2-inch head specified in the New York and New Jersey codes is a trifle lenient. For an absolute lower limit it is perhaps scarcely possible to go much beyond this figure, but we would suggest that a fairer measure of actual performance would be obtained by specifying that the suction head in the exhaust pipes of a polishing shop should at no point fall below 2 inches, and should average 3 inches when measured at a number of different points.

The next point of interest is the linear velocity of the exhaust air current maintained at the throat of the exhaust duct.

This velocity in installations that are operating satisfactorily generally varies from 1500 to 5000 feet per minute and has averaged in our studies about 2500 feet per minute, while a lowering of the velocity below 1500 feet has been promptly followed by an increase in the dust content of the air.

We have found in the examination of polishing shops equipped with well-designed exhaust systems that it is perfectly possible to keep the weight of dust in the air in the proximity of the wheels down to an average of 0.03 mg. per cubic foot with maximum figures not rising above 0.06 mg. In grinding shops the weights are likely to rise somewhat higher, the results for such a workroom presented in Table 14, for example, rising to 0.05 mg. for an average and 0.1 mg. for a maximum. We may tentatively conclude that in a polishing shop the weight of dust in the air can be constantly kept below 0.06 mg. per cubic foot and should not average over 0.03 mg., while for a grinding shop these values should perhaps be doubled. These figures are lower than the standards of 0.14 mg. per cubic foot and 0.28 mg. per cubic foot set, respectively, by the South African commission and by Higgins and Lanza for mine air; but it is obvious that the air of a polishing shop can, and therefore should, be kept freer from dangerous dust than that of a metal mine.

It has been pointed out above that it is the small dust particles which are of chief importance, so that a standard based on the number of one-fourth standard unit (1–10 microns) particles in the air should prove even more valuable than one based on weight. So far as the number of small dust particles is concerned, there is no great difference between well-equipped grinding and polishing shops. In either case, our studies indicate that the dust content of the air can be kept generally under 300,000 one-fourth standard unit particles per cubic foot and should not average over 200,000 such particles.*

These standards are only tentative and must be subject to revision with the development of a wider knowledge of the air conditions in representative workrooms. They are, in any case, applicable only to grinding and polishing shops, and the standards which can reasonably be applied in other processes must be determined by similar studies under actual working conditions. The carrying out of such studies on a large scale and in many different industrial processes is essential to the formulation of standards of air dustiness which shall place this important branch of industrial hygiene upon a firm foundation.

* All data in this paper were obtained with the Palmer apparatus and standards must, of course, be modified if a method is used which gives higher values for a given sample of air.

BIBLIOGRAPHY

(For bibliographical references numbered less than 15, see Part I of this article in the preceding issue of this Journal.)

15. Hill, E. V.: Quantitative Determination of Air Dust. Heating and Ventilating Magazine, 1917, **14**, 23.
16. Macfadyen, A., and Lunt, J.: Bacteria and Dust in Air. Trans. Brit. Inst. Prev. Med., 1897, **1**, 142.
17. Palmer, G. T.: A New Sampling Apparatus for the Determination of Aërial Dust. Am. Jour. Pub. Health, 1916, **6**, 54.
18. Final Report of the Committee on Standard Methods for the Examination of Air. Am. Jour. Pub. Health, 1917, **7**, 54.
19. Inness, J.: The Estimation of Injurious Dust in Mine Air by the Kotzé Konimeter. Jour. Chem. Met. Min. Soc. So. Africa, 1919, **19**, 132.
20. Bill, J. P.: The Electrostatic Method of Dust Collection as Applied to the Sanitary Analysis of Air. Jour. Indust. Hyg., 1919–1920, **1**, 323.

21. Katz, S. H., Longfellow, E. S., and Fieldner, A. C.: Efficiency of the Palmer Apparatus for Determining Dust in Air. Jour. Indust. Hyg., 1920–1921, **2**, 167.
22. Report (Fourth Supplementary) of the Committee on Standard Methods for the Examination of the Air. Am. Jour. Pub. Health, 1920, **10**, 450.
23. Miller, T. G., and Smyth, H. F.: The Dust Hazard in Certain Industries. Jour. Am. Med. Assn., 1918, **70**, 599.
24. Winslow, C.-E. A., Greenburg, L., and Angermyer, H. C.: Standards for Measuring the Efficiency of Exhaust Systems in Polishing Shops. U. S. Pub. Health Rep., 1919, **34**, 427.
25. Winslow, C.-E. A., Greenburg, L., and Greenberg, D.: The Dust Hazard in the Abrasive Industry. U. S. Pub. Health Rep., 1919, **34**, 1171.
26. Palmer, G. T., Coleman, L. V., and Ward, H. C.: A Study of Methods for Determining Air Dustiness. Am. Jour. Pub. Health, 1916, **6**, 1049.
27. A Simple and Inexpensive Respirator for Dust Protection. N. Y. State Dept. Labor, Bull. No. 90, Dec., 1918, pp. 10.
28. Kobrak, E.: Respiratoren zum Schutze gegen die Einatmung Infektiöser Tröpfchen und Stäubchen. Ztschr. f. Hyg., 1911, **68**, 157.
29. Schablowski: Ueber Respiratoren bei Gewerblichen Staubarbeiten. Ztschr. f. Hyg., 1911, **68**, 169.
30. Winslow, C.-E. A., Greenburg, L., and Reeves, E. H.: The Efficiency of Certain Devices Used for the Protection of Sand Blasters against the Dust Hazard. U. S. Pub. Health Rep., 1920, **35**, 518.

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Motion Study for the Handicapped. By Frank B. Gilbreth, Major, Engineers, R. C. (honourably discharged), Consulting Management Engineer, Member Franklin Institute, American Society of Mechanical Engineers, Past Vice-President Society for the Promotion of Engineering Education, Author of *Fatigue Study*, *Applied Motion Study;* and Lillian Moller Gilbreth, Ph.D. Cloth. Pp. 165, with illustrations. London: George Routledge & Sons, Ltd.; New York: E. P. Dutton & Company, 1920.

The Major Symptoms of Hysteria. Fifteen Lectures Given in the Medical School of Harvard University. By Pierre Janet, Ph.D., M.D., Member of the Institute of France, Professor of Psychology in the Collège de France. Second edition with new matter. Cloth. Pp. 345, with illustrations and index. New York: The Macmillan Company, 1920.

The Human Factor in Industry. By Lee K. Frankel, Ph.D., Third Vice-President, and Alexander Fleisher, Ph.D., Assistant Secretary, Metropolitan Life Insurance Company, with the co-operation of Laura S. Seymour. Cloth. Pp. 366. New York: The Macmillan Company, 1920.

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | MARCH, 1921 | NUMBER 11

INDUSTRIAL MEDICINE AND THE IMMIGRANT*

MICHAEL M. DAVIS, Jr., Ph.D.

AND

LINDA JAMES

Scope and Problems

WHILE most manufacturers are probably conscious that they employ numbers of "foreigners," a few figures may make more evident the importance of giving special consideration to this group in industry today. In 1908–1909 the United States Immigration Commission made an investigation of immigrants in industries, which contains much valuable material for the captain of industry and his medical lieutenants, the industrial physicians. Jenks and Lauck (1) summarized these facts in their book, from which the following quotations are made:

> . . . Only one-fifth of the total number of wage earners in twenty-one of the principal branches of industry were native white Americans, while almost three-fifths were of foreign birth; 14 per cent. were industrial workers of the second generation, or of native birth but of foreign father; and 5 per cent. were native negroes. About 30 per cent. of all the females, as contrasted with 14 per cent. of the men, were native born of foreign father. . . . Altogether fifty-six different races appeared in the working forces of the mines and manufacturing establishments included in the recent comprehensive inquiry of the Immigration Commission. Thirty-seven of these races were of the south and east of Europe, or of the Orient. Almost one-half of all the wage earners were from southern and eastern European countries. The proportion of foreign born among the operating forces of the principal branches of manufacturing and mining were as follows: more than one-half of the iron and steel workers, employees of oil refineries, slaughtering and meat-packing establishments, furniture factories, leather tanneries and finishing establishments, woolen and worsted goods, and cotton mills operatives; about two-fifths of the glass workers; one-third of the silk mill operatives, glove factory employees, and cigar and tobacco makers; seven-tenths of men and women garment makers; more than one-fourth of the boot and shoe factory operatives; four-fifths of the wage earners in sugar refineries.

A glance at a few payrolls (Table 1) analyzed by race will make clear the variety as well as the number of foreign-born employees in factories and mining regions of the United States. Comparatively few companies keep any record of race, and of those who do not many have ever analyzed their data. The first payroll given is from a typical New England leather factory. The second is from a corporation manufacturing machinery in Ohio, Wisconsin, and Illinois. The last is not a payroll but represents the

* The material on which this article is based was secured by the authors during a study of the health problems among immigrants, made as part of the Americanization Study of the Carnegie Corporation. A portion of this material will appear as a chapter in the book on *Immigrant Health and the Community* by Michael M. Davis, Jr., Harper & Bros., publishers. The field work was done during 1918 and 1919 and the data should be interpreted with these dates in mind. Received for publication Sept. 9, 1920.

TABLE 1.—PAYROLLS OF THREE COMPANIES ANALYZED BY RACE

1

French	438	Greeks	53
Lithuanians	379	Armenians	42
Italians	362	Jewish	39
Irish	294	Russians	36
Polish	196	Scotch	35
Americans	173	Assyrians	16
English	130	Miscellaneous	73
Syrians	81		
Swedes	57	Total	2,404

2

		Per Cent.			Per Cent.
Americans, white	5,283	47.9	Japanese	1	..
Americans, colored	278	2.5	Jews	30	.3
Argentineans	1	..	Kreiner	5	..
Armenians	20	.2	Lithuanians	312	2.8
Albanians	20	.2	Luxemburgers	3	..
Austrians	294	2.7	Norwegians	76	.7
Belgians	8	.1	Persians	5	..
Bohemians	174	1.6	Poles	1,454	12.9
Bulgarians	3	..	Roumanians	12	.1
Canadians	25	.2	Russians	177	1.6
Croatians	74	.7	Ruthenians	6	.1
Danes	31	.3	Scotch	22	.2
English	63	.6	Serbians	42	.4
Finns	4	..	Slavonians	137	1.2
French	16	.1	Spaniards	2	..
Germans	810	7.4	Swedes	147	1.3
Greeks	302	2.7	Swiss	17	.2
Hollanders	216	2.0	Syrians	15	.1
Hungarians	506	4.6	Turks	8	.1
Irish	52	.5	Ukrainians	8	.1
Italians	341	3.1	Welsh	22	.2
Jamaicans	2	..	West Indians	1	..
			Total		11,025

3

Population of thirteen towns, Mesaba Range, Minnesota (2)

Americans, white	12,000	North Italians	1,000
Finns	7,300	Poles	800
Slovenians	3,600	Slovaks	800
Swedes	3,580	Serbians	515
Croatians	3,400	Bulgarians	460
South Italians	3,300	Bohemians	315
Montenegrins	2,600	Greeks	218
Irish	2,200	Syrians	110
Norwegians	1,300		
Jewish	1,000	Total	44,498
Foreign born	73%	American	26.9%

racial elements in the iron and copper mining towns of Minnesota and Michigan.

According to the U. S. Census of 1910 (3), 59.9 per cent. of the foreign born were between the ages of 15 and 45 years. The corresponding percentage among the native born was only 45.9. A much larger proportion of the immigrants in this country are of working age than among the native born. No survey of the health problems and of methods of medical and health work among the foreign born would be complete without considering the place in their lives which industrial medicine occupies. Does the immigrant employee, because of his foreign birth, present special medical, sanitary and health problems to the industrial physician? If so, what methods of solving these problems are being tried out and with what success, and what is the interrelation of industrial medicine to the general medical service and health work of the community?

As in other branches of this study, information was secured partly by questionnaires and partly by personal visits and interviews. In planning this investigation and in securing lists of industrial physicians and others, much help was given by Dr. Harry E. Mock, Dr. George M. Price, Dr. Alice Hamilton, the Pennsylvania Health Insurance Commission and the Minnesota Department of Health. The replies to the preliminary questionnaires furnished many suggestions as to desirable persons and places to visit. Health conditions and problems vary with the location of an industry, with its character, and with the racial elements among its employees. Consequently, manufacturing establishments in large cities and in small towns, mining communities in several parts of the United States, and, finally, some mercantile establishments were visited in a number of places wherein different races predominated. The Atlantic Coast states, the regions around Cleveland and Chicago, parts of Pennsylvania, Minnesota, Michigan, Colorado, and California were included. About fifty different establishments were visited, usually five or six people being interviewed in each.

The industrial physicians, the nurses, the safety and sanitation departments, and the employment managers, were the persons sought for. Thus, this report is a survey of a variety of situations and viewpoints.

To get the industrial physician's own conception of what problems the immigrant brings to him the questionnaire method was the first used. Seventy replies were received, of which twenty-two (31 per cent.) said that housing conditions in relation to the foreign-born employee were a cause of grave concern. Twelve (17 per cent.) recognized that immigrant foods and food habits were problems. Ten (14 per cent.) mentioned the personal hygiene of the foreign-born employee in relation to factory sanitation and efficiency of the worker. Six, whose firms employed large numbers of Slavic peoples, spoke of alcohol. Six mentioned the need for instruction in English, so that health education might be of avail. Seven mentioned tuberculosis; and six, occupational diseases. A significant item was the small number (only three) who appeared to have recognized the need for dental care. Other points brought out by these questionnaires will be found in Table 2.

It is obvious that many of the problems mentioned in the questionnaires are more or less common to all employees of industry, as well as to the foreign born. But as we have seen, the immigrant is affected by the complicating influences of language, unfamiliarity with American conditions, habits of life derived from an entirely different environment, etc. Only a few of the persons who answered our questionnaires or who talked matters over in our interviews had given serious thought to the medical and health problems peculiar to the immigrant employee, or to special methods for dealing with these problems. Some of these few, however, had much to contribute, as will appear. First, let us take up certain general points.

TABLE 2. — ANALYSIS OF QUESTIONNAIRES SENT TO INDUSTRIAL PHYSICIANS JULY, 1918

Number sent out	354	
Number returned	80	
Per cent. returned	23	
Of the 80 answers received:[1]	Number	Per Cent.
1. Do nothing with foreign born or men in United States Military Service	10	12.5
2. Take care of accidents chiefly	14	17.5
3. Extend medical service in some degree	10	12.5
4. Place employees at work according to physical fitness	29	36.3
5. Give miscellaneous constructive suggestions	20	25.0
Of the 70 answers with suggestions:[1]		
1. Examine applicants for work	38	54.3
2. Re-examine other employees	42	60.0
3. Not examining all employees, but feel need of doing it	4	5.7
Outstanding problems as presented by the 70 questionnaires:[1]		
1. Housing conditions	22	31.4
2. Kinds and preparation of food	12	17.0
3. Personal hygiene	10	14.0
4. Tuberculosis	7	10.0
5. Alcohol	6	8.5
6. Occupational diseases (chiefly lead poisoning)	6	8.5
7. Trachoma	4	5.7
8. Bad teeth	3	4.0
9. Venereal disease	2	2.8
10. Hernia	2	2.8
11. Feel need of extension of medical service to homes	3	4.0
12. Feel need of teaching English language	6	8.5

[1] The same questionnaire may fall under more than one grouping.

We find in the responses expressions of every point of view, from the big stick theory up. Thus one doctor writes:

> There is an endless field for doing good, and we are desirous of doing our part; especially teaching these men of foreign birth to respect and honor their adopted country. Teach them how to live in their homes, and make them desirable citizens, proud to live [in the United States].

A contrast to this paternalistic approach is the following:

> If given a square deal, housed in habitations fit for humans rather than hovels and rabbit warrens, appealed to by means of pictures, talks in their own

language, and an HONEST desire to help *them* rather than as it has been — work them to death, pay as poor a wage as possible to compel them to accept . . . this is my idea of . . . what might be done to make them better physically, mentally. We MUST meet them on the level, and not from a superior height and be condescending.

The doctor who would force the immigrant to conform to our standards is well represented in the questionnaires. One physician suggests that we "eliminate as far as possible all foreign institutions"—a suggestion which comes in the same breath with "abolition of the saloon." Another doctor feels the great need of "education of the employer," if these problems are to be solved. He is seconded by one who writes that both "employer and employee must be educated, the former to spend money for a first-class [welfare] organization, and the other to accept graciously that which makes he or she a more valuable worker."

Among employment managers, the chief concern seemed to be the housing problem and the alcohol question. Since these two factors are intimately associated with labor turnover and absence from work, it is natural that the employment manager should feel the additional pressure imposed by the presence of many foreign-born employees. The teaching of English in relation to labor turnover also interested employment managers; but that lies outside the field of health, and was only touched on indirectly in our investigation.

Safety and sanitation departments in a few instances were considering the additional hazards which non-English speaking employees present. When it came to the question of factory sanitation, nearly all admitted that the foreign-born employee raised special problems, but practically none had done anything toward solution. Misuse of toilet facilities and promiscuous spitting were generally complained of as intensified where immigrants were present in any numbers.

Where the work of an industrial physician or surgeon is confined to treatment of accidents and emergencies, it is natural that the immigrant should be lost sight of in the monotonous routine of the work itself. But despite the increased opportunities for service which rapidly evolving industrial medicine is now giving, a surprisingly limited number of doctors have considered the difficulties which the immigrants present to them. As a rule, the nurses employed by industrial establishments had much more consciousness of these difficulties than had the doctors under whom they worked. This may probably be accounted for by the fact that the nurse usually sees the home as well as the employee in the factory, and therefore has a more rounded conception of the individual's life than the doctor, who is only too apt to limit himself, as well as his work, to the confines of the clinic walls. Housing, food difficulties, personal and factory hygiene, alcohol, venereal diseases, inability to secure the confidence of the employees, were among the chief difficulties which the nurse felt to be accentuated by the presence of the immigrants in a factory.

One physician, head surgeon of a very large industrial concern in New England, had been impressed by the influence of bad housing upon the physical fitness of the foreign-born employee. He advocated giving an industry complete and absolute control over the health of its workmen. He even felt that communities should deputize industrial agents as sanitary inspectors for the purpose of enforcing regulations in the homes of employees of the industries concerned. Force was his only suggestion as a solution for the problem of sanitary homes for the immigrant workman.

The following anecdote illustrates better than anything else a prevalent attitude toward the immigrant employee. It brings out the language barrier, the indifference or contempt of many native born toward the

immigrant, and the frequent lack of a social consciousness on the part of nurses and employment managers. This incident happened during the process of interviewing, and is quoted direct from the notes made at the time.

> While I was talking with one of the nurses, a Hungarian, small and dirty, and violently gesticulating and speaking broken English, came bursting in the room next ours. The employment manager stepped in from the next room to try to quell the disturbance. As I passed through where they all were, the nurses and employment manager were standing in great annoyance, laughing at this little man. He was so frantically eager to make them understand his trouble that he was weeping at his inability to do so, while they merely grinned at him.
>
> As the employment manager came into the room where I stood, I asked what the trouble was.
>
> "Oh, that man's wife is sick and he wants us to pay the meat bill" — then he laughed. How many facts lay behind that statement I could not tell, nor was any sincere attempt made to find out from the man what was the specific cause of his distress. He went out, returning in a few moments still shaken by his excitement, to find the door ordered locked against his re-entry.

Some comprehension of the European backgrounds and native characteristics of the races represented in our industries is necessary if we are to understand the problems which they are bringing to the industrial world. How can a doctor or superintendent of sanitation in a factory pretend to deal with the difficulties forced to his attention by the presence of the foreign born, if he knows nothing of their inherited ideals, customs, and standards of living? Each race differs from every other, and he who would make intelligent efforts to solve the problems brought by each race must first understand their racial heritages. Misuse of toilets and promiscuous spitting, for example, irritate and anger industrial managers. If one is familiar with the fact that many of the immigrants have lived outdoor lives and had never seen a water-flushed toilet before coming to the United States, one gets a new conception of the problem confronting him, and, what is more, a new understanding of the viewpoint of the immigrant himself. That is the first step toward intelligent corrective action. Is there an industrial physician who feels anything but exasperation at the personal uncleanliness of an immigrant employee? Does the physician, however, know what the race habits of this people were with regard to bathing, or what bathing facilities this particular man now has in his American home? To try to accomplish the best results in preventing accidents, curing disease and promoting health and efficiency among foreign-born employees, requires a consciousness of immigrant backgrounds and characteristics, combined with a knowledge of the conditions under which immigrants live in this country.

The ideal attitude of industry toward this question is given by Charles E. Knoeppel in an address before the American Society of Mechanical Engineers in 1918 (4).

> The manager of the future . . . will love men, and will work with them to make them better men. He will study men, for in the last analysis men are, and always will be, the foundation of industry and civilization. . . . Man is the foundation; therefore, know man; for a thorough knowledge of man, and of men, will be the keystone in the industrial structure of the coming age. . . .

Medical Service in Industrial Establishments

Medical service within the industrial plant for the employees is a subject of great importance in relation to the foreign born. A brief introductory history of industrial medical service will, therefore, be useful.

Most industrial clinics originated as a result of accident compensation laws. In their early history a first-aid kit was kept in the building and arrangements were made with doctors to answer calls for emergencies. The next step beyond this was the installation of first-aid stations within the plant itself, with a nurse employed full

time, and a surgeon still on call for serious accidents. Selby (5) in his study of 118 plants with clinics found that 14 per cent. had what he called "detached emergency service" — that is, doctors were summoned only in case of accident. Then there came the physical examination of the applicants for work, as well as periodic re-examinations of those exposed to industrial health hazards, such as lead. From this it was not a far step to having physicians as well as nurses present all day. Selby found that 65 per cent. of the 263 doctors in the plants he visited were full-time men. Following this, the best among these doctors and nurses, seeing the great opportunities which lay before them to be of service to the employees as well as to the industries employing them, began to broaden the scope of their work. Today the most advanced among them have succeeded in extending medical service to the homes of the workers and have installed various specialties in their clinics, such as X-ray plants, oculists, and dentists. They study health conditions and hazards in the factory, for the purposes of preventive medicine. Educational literature and health talks are also included in the activities of a few departments. Selby found four establishments with oculists. Health bulletins issued by the National Safety Council were used by 16 per cent. of the 118 places visited, and health talks were given in 12 per cent.

The idealistic attitude toward this work is well expressed by one of its distinguished leaders, Dr. Harry E. Mock, in the *Journal of Industrial Hygiene* for May, 1919 (6):

> This new specialty of industrial medicine and surgery includes every scientific branch of medicine and in addition requires a keen understanding of practical sociology. Its field is so broad that it involves specialists within this specialty — yet each worker in this field must be thoroughly trained in its general aspects.
>
> The problems of the family physician concerned the individual and the family. The problems presented to the industrial physician concern the individual, the family, and the large group associated with him — his fellow-employees and employer.
>
> Specifically the scope of this work deals with the human maintenance equation in industry. It involves the prevention of disease and accidents among the entire group of employees; the constant supervision of the health of the employees, including a study of each individual, the working conditions, the hazards of each occupation, the question of hours of labor and wages, the daily intercourse between the employer and the employed as well as between fellow-employees, and the home environments of the working force; adequate medical and surgical care of the sick and injured; compensation and benefits during periods of disability; the selection of occupations according to the physical qualifications of the individual; the restoration of the disabled to an economic usefulness; it involves, in fact, every human equation in this problem which affects the health and efficiency of the individual or of the entire group of employees.

Within this scope, what recognition has there been of the special problems of the immigrant employee, and what has been done to meet them? The best method of learning what measures have been taken toward a solution of these problems is to follow an individual immigrant through a typical industrial clinic. His first point of contact is, of course, the man at the desk in the employment office. If our applicant understands any English, he will get by there somehow. If not, some friend or neighbor may help out, or he will have to talk as best he can by signs. In one particular factory, which we are taking as example, he is then sent to the clinic for physical examination before placement at any job. Here his troubles increase. He is stripped — without knowing why or wherefore in many cases, because he cannot understand what is being said around him or to him. Then the doctor makes his examination. How common a sight it is to see doctor and prospective employee standing facing each other, helpless, with no common tongue and no common understanding of each other's outlook toward the work in

hand. How can an English-speaking physician hope to get a personal history from an immigrant who understands at best only a little English, and who speaks very imperfectly? How can the doctor explain the necessity of remedying the physical defects that he finds in such a way that the man may become a more efficient workman for the company which is going to employ him? If the employee knows a little English he may catch the words "operation," "cut," or "hospital," and terror at once may fill his soul. A casual interpreter dragged in either from the plant or from outside cannot serve effectively in a situation like this. An interpreter, who is familiar with medical and social work and who also understands the racial heritage of the man concerned, is needed. To work through an interpreter is clumsy at best; but how infinitely more difficult it is to secure results with an ignorant and untrained person who happens along and seems to know the language, than with someone regularly employed within the clinic who knows its aims and functions. The employer who neglects this fact is wasting many dollars spent on doctors for lack of as many dimes that should go for nurses, social workers, or interpreters.

If the new employee is to be assigned to a job which is hazardous from the viewpoint of industrial disease, the physician is again met with the barrier of language and the man's unfamiliarity with American industry. Poisons, protection from which means careful personal habits and cleanliness, are many times more a hazard to such a workman than to the native born. To make clear the hazard of something which the workman cannot see, such as wood-alcohol vapors, is impossible if he cannot understand the language of the instructor.

It is not at all unlikely that the man, whom we have been following through a clinic, is very dirty. The doctor's first and peremptory orders are to take a bath — not once, but frequently. Then he cannot understand why his orders are not carried out. To suggest frequent baths to an American is not such a great shock. He at least knows of our bathing customs and is familiar with city water supplies and bathtubs. But to the newly arrived immigrant such a suggestion may indicate lunacy or evil intent. Roberts (7) has cited some vivid examples of attitudes of mind which some immigrants held toward frequent bathing.

Mr. Shadwell says of the Germans: "To any one who remembers the Germany of old, when no one could swim, bathing was thought a proof of insanity, and washing a dangerous eccentricity — no change is more remarkable than the conversion in this respect."

A young Pole was induced to go into the swimming pool in a Young Men's Christian Association; after that he kept away from the building, and the secretary went to find out why he stayed away. The mother of the lad met him, gave him a piece of her mind, that he dared make her boy take a bath in winter time. "Did you want to kill him?" Thousands of immigrants from southeastern Europe do not appreciate the value of personal cleanliness.

Another very important way in which the industrial physician can aid his employer to reduce disease and accident is to make an entry of mother tongue and nationality on his medical records, and then analyze statistics by race. The making of the original entry may be the duty of the employment department, but the medical department should know and utilize the facts, a thing which so few industrial clinics do, that this point cannot be too strongly stressed. Among our field notes on industrial interviews we frequently ran across such entries as this:

Nurses had no knowledge of races in plant, number of employees, nor of diseases or accidents by races. Never analyzed their records. Struck them as new idea. Did not even know that there was a place on their medical record for nationality entry. No knowledge of plant conditions or hazards.

A few doctors with the analytical type of mind have already included on their med-

ical records data in regard to nationality and have utilized the information, to the great advantage, not only of the company employing them, but also of our growing knowledge of the specific problems to be met. For instance, one of these men found by analysis of his records that hernia occurred more commonly among the southeastern Europeans employed by the company—Italians in particular—than among other races doing the same kind of work. The marked prevalence of rickets among Italian children, both in Italy and America, interested him greatly in this connection. His next step in regard to this observation, which grew out of careful analysis of records by race, will probably be a study of food habits among the Italian employees. This same doctor has noted more pernicious anemia among Swedes than among the southern European races. So he will go on analyzing the data secured day by day in the routine work of the clinic. This knowledge he applies at once to the practical demands of his industry. He is making scientific contributions to our imperfect knowledge of the problems brought to industry by the immigrant. There is a great need for more extended study of this kind so that industrial physicians hereafter may have sound statistical material on which to base action relative to foreign-born employees.

It has already been pointed out that the large majority of workers in railroad and construction camps are foreign born. Medical service for such "floating labor" is in a sadly undeveloped state. These workmen live in temporary camps at certain periods of the year, but many come to the cities to spend the winters. The provision of medical facilities for immigrants in little isolated lumber or ice camps is important to the state as well as to the individual. These men are often sources of infection because they spread contagious disease as they travel.

In Wisconsin, Leiserson (8) found that hospital and medical facilities were lacking in most camps. In two camps he found a deduction of fifty cents made from the employee's pay envelope for hospital fees. Sometimes there were hospitals not far from the camps, but often it was very difficult to get medical care. This meant that an ill man was shipped out of camp to find his way to medical aid alone. Inquiry was made, at this time, of hospital and health officers in the state relative to the cases of disease which could be traced to these labor camps. The results of the investigation indicate that the camps are a menace to even far-distant communities. Of the fifteen cities which replied, seven had kept more or less complete records of place of origin of contagious diseases during the preceding three years. The following cases were claimed to be directly traceable to insanitary camp conditions within Wisconsin: typhoid 159; smallpox 12; diphtheria 6; others 28 (measles 5, scarlet fever 3, meningitis 1, erysipelas 19). The greatest number of cases of contagious diseases were reported from lumber camps, the railroad camps ranking second.

In Minnesota the large lumber companies usually provide for medical service through the "contract system." The contract surgeon is located at the nearest town of any size, and either the men are shipped out to him when ill or he goes to the camp. There are good hospital facilities on the Mesaba iron range to which the men can be taken in case of accident. Contagious diseases, however, offer the same problem here that they do in Wisconsin. The Division of Communicable Diseases of the Minnesota State Department of Health has on record many interesting cases of typhoid fever associated with temporary labor camps. Such lack of attention to the medical and health problems of the labor camp is a serious one for the public welfare, and for the efficiency of industry as well.

It can be adequately dealt with only by state and, in some cases, by federal authority.

A few industrial physicians have extended medical service from the plant itself to the homes of the employees. The value of such service to the immigrant and his family is great, especially if obstetrical care and medicines are included. Not all physicians are, however, agreed as to the advisability of doing this. It is contrary to the policies of such representative plants as the Norton Company in Worcester and the Goodrich Company in Akron, Ohio, the doctors in which feel that the industrial physician should not infringe on the private practice of others in the community. Both plants are, however, located in large cities where other medical facilities are numerous. Endicott Johnson and Company of Endicott, N. Y., practise exactly the opposite point of view. They have three nurses for visiting the homes and another three for clinical activities. Obstetrical services are given free, as well as eye, ear, nose and throat treatment for families of employees. Their visiting nurses make both prenatal and postpartem calls.

Apparently the attitude of a company toward this question is guided to a large degree by the size of the community where it is located and by the other medical resources which are available in the vicinity. This question of the relationship between industrial medicine and community medical service is more fully discussed in the description of industrial medicine in the mining regions. The boundary line of responsibility is a delicate and changing one and decision requires careful analysis of the environment of any industrial establishment which may be under consideration. In most places where physicians employed by the industries are the only ones available, it is of utmost importance to the immigrant employee that his family have access to the doctor's services. Moderate prices mean more prompt medical care and this, in turn, means reduction in time lost because of illness of the worker or his family. Not only this, but nursing aid extended to the homes has great value in any locality.

The nurse is a means to a definite end when dealing with the immigrant. Probably she, more than any other person, has the most welcome admission to the homes of the foreign born. She comes on errands of mercy and helpfulness. Her mere presence brings much relief from worry to the immigrant and thus raises his working efficiency. That is one reason why it is so disastrous for an industry to use a nurse as a truant officer in following up absences among the immigrant workers. They soon feel that she whom they have turned to as a friend in time of illness has become a spy and intruder in their family life. Resentment, of course, results at once, and kills all the opportunities which the nurse had to carry out educational work in connection with her friendly aid. Hers is the chance to help the immigrant to adjust his food habits to the demands of the American life and so increase his working capacity; to teach him American standards of hygiene and sanitation as they apply to both the factory and home; and, lastly, to spread knowledge as to the proper care of his children who are to be the workmen of tomorrow.

The extension of medical service by means of nurses from an industry to the homes of its employees may be one of the most valuable aids to Americanization. It must be done so that the immigrant is not made to feel in any way that his private affairs are being intruded upon. Only by slow winning of his confidence and by respecting the trust he shows, can extension of medical service be made of value to him and to the industry which employs him.

There are a number of accident and sickness insurance schemes for the employees of an establishment, which are

found in concerns having many foreign-born employees. Notable is that of the International Harvester Companies, whose employees' benefit association dates from 1908. Over 50 per cent. of the employees are said to be of foreign birth. Sick benefits, disablement benefits, and death benefits are provided from a fund made up by contributions from members of $1\frac{1}{3}$ to $1\frac{1}{2}$ per cent. of wages, plus certain contributions from the companies. The board of trustees is chosen half by the employees, half by the companies. Medical care is not furnished. The average percentage of membership from the manufacturing plants during 1917 was 78.4 per cent. Large numbers of foreign-born employees are included. Even this plan — certainly one of the most successful of its kind — does not assure competent medical service at reasonable rates. The employee receives as sick benefit half his usual weekly wage, and is required to take care of himself "and have proper treatment." How to pay for doctors' fees and medicines in addition to the regular living expenses of the family, on half the usual income, must usually be a hard nut to crack. Plans of this type are a definite help to many families, but do not in any way solve the problem of providing adequate medical care. Most such plans involve much less participation by the employees than does the one above described.

In addition to industrial medical service supported by the employer, there are several plans existent among the workers themselves. The Joint Board of Sanitary Control in New York City furnishes perhaps the most prominent example. This organization, of which Dr. George M. Price is the director, is managed and supported by workers in certain women's garment trades of New York City. This board touches the lives of over 75,000 workers in more than 2,700 industrial establishments. Through these employees in the clothing industries of New York, who are united under the protocol of peace, the board supervises conditions of safety, sanitation, and general conditions relating to health in the factories where its members are employed. It seeks to enforce standards "not by police power or compulsion, but by education, co-operation, and educational persuasion" (9). In 1912 a clinic was established for voluntary examinations of all workers in the industry. Through it are directed the supervision of sick benefits paid by the locals of the union. The unions also pay for sanatorium treatment for members suffering from tuberculosis. Nose, throat, eye and ear and dental clinics are included among the services provided. "The main significance of these clinics lies, of course, in the fact that they are conducted, financed and managed by the workers themselves, for their own benefit" (9, p. 50). As large numbers of the garment workers are Jews and Italians, either foreign born or the first generation here, it is evident that such an organization bears a close relation to the problem of medical care for the immigrant. Only a minority of the members, however, appear as yet to make regular use of their clinics.

Still another phase of industrial medicine with which the industrial physician should be familiar is to be found also in New York City. Dr. Louis I. Harris, of the New York City Department of Health, established a relationship between the unions in the city of New York and the Division of Industrial Hygiene, known as the Labor Sanitation Conference, a detailed description of which is given in the Monthly Bulletin of the Department of Health of New York City for June, 1917 (10). This was an endeavor to associate labor unions and a city department for the common end of improving general health conditions in the factories of the city. Education both of employees and of employers was a prominent part of the work. The police power of the city department was used when need arose, while the

750,000 members of the affiliated unions acted as voluntary inspectors for the department. On one occasion, the department conducted physical examinations on a voluntary basis for union members. These were largely foreign born.

Such plans, to be successful, require the voluntary co-operation of all workers concerned. This involves an immense amount of educational work if the immigrants are ever to respond to the advantages offered. Most of the foreign born are not so much interested in health as they are in personal illness. Sickness makes them think of the health they have had, but so long as they are well it is very difficult for them to appreciate the need of preventive work and that is the problem in which these organizations in New York City are ultimately interested.

It should be apparent that such plans for co-operative medical service by and for employees will not supersede the well-developed clinic in an industry. Many medical and sanitary problems are closely linked with the individual factory and can best be dealt with inside of the factory. Such a clinic should maintain supervision of the conditions under which the immigrant works and of his health, and directly or indirectly should see to it that medical care for the worker and his family is available and within his means. Whatever tends to keep workers well, tends also to stabilize labor conditions. Good medical service to employees means also service to employer.

Dr. Otto Geier, a physician of many years experience in industrial medical service, writes that:

> . . . The industrial dispensary will lessen disease, increase the number of working days as well as working capacity, and thereby increase the purchasing power for adequate medical service for the families of the workers. Medical care in industry is not a charity. It pays the best dividends of any department in business. It secures a new arm to the health department and makes possible preventive medicine on a scale yet undreamed of. Witness the reduction of 75 per cent. of the time lost on account of illness in the employees of the Norton Company who use the medical department. In attacking directly such problems as personal hygiene, bad housing and living conditions, alcoholism and venereal disease, it will make a real contribution to national health and social welfare (11).

Industrial Medical Service to Communities

Nearly all of the industrial clinics are supported entirely by corporation funds. The employee is a recipient of something which he may or may not welcome, the burden of the support of which he in no way shares. In a very few instances, as we have seen, the workers themselves have initiated something in the way of medical care. In a few other cases, the employer has extended medical service outside of the plant to the employee and his family in their home. In certain mining regions, however, the service extends far beyond this.

The data which follow were secured by visits to the Mesaba and Vermillion iron ranges of Minnesota and the copper range on the northern peninsula of Michigan. Several towns were visited on each range.* The medical service for the community at large and for the industries is so closely interlocked that the description of one necessarily involves the other. In each town visited an attempt was made, first, to study the health problems presented by the most numerous races; second, to study medical service connected with the industries; and, third, to find out what medical facilities were available to the whole population so that the value of this type of industrial medical service could be fairly judged.

Data were secured by personal interviews with "contract doctors," foreign physicians, the superintendent of a mining company, school nurses and school doctors,

* In Minnesota: Ely, Virginia, Hibbing, Buhl, Eveleth; in Michigan: Calumet and Hancock.

health officers, heads of lodges and secret societies, and from nurses and social workers. Personal observation of housing conditions was of assistance. In these mining towns, the industrial group and the community are substantially identical. The medical service developed by the mining companies for their employees is practically all the medical service there is for anybody. It is community medicine under industrial auspices. Since 75 to 93 per cent. of the people on these ranges are of foreign birth or stock, the problems of the health and medical care of the immigrant are largely involved.

Of the regions visited, the copper range in Michigan is the one which has been longest worked — sixty years at some of the old shafts. The Mesaba iron range is a development of the last twenty years. According to the Report of the U. S. Immigration Commission in 1909 (2, p. 83), the Finns were the first foreigners to be employed. The Cornishmen, who were skilled miners in the "old country," came next. Since about 1900, the Poles and southeastern Europeans, Italians, and "Austrians" (chiefly Croatians and Slovenians) have been coming in greater and greater numbers. The Finns, nevertheless, still outnumber the others. There has been a steady westward migration of all these races, first to the Vermillion iron range, then to the Mesaba, and then on to the Montana, Colorado, and Arizona mines. Demand for skilled labor, higher wages, and strikes have been factors in causing this westward movement. Many of the Finns leave the mines and become farmers. Today the chief races which are involved in the system of medical service about to be described are the Finns, Slovenians, Croatians, and Italians. Different races predominate in different towns, but all are represented in each.

The kind of mining, to a certain extent, determines the racial constituents of the population. Where skilled miners are required, in the underground workings of the Vermillion and copper ranges, there will be found larger numbers of Cornishmen, Scandinavians, Irish, and Americans than in the open pit mining on the Mesaba. In the unskilled positions on all ranges are to be found the Finns, Slovenians, Croatians, and Italians.

These mines when first opened were in a wilderness. The companies had to build houses for their workmen, provide water supplies and sewage systems, take care of garbage and ash removal, and maintain the streets. Today, on the copper range, these activities are still controlled by the companies to a large degree. On the Mesaba range, houses are still owned by them, but the other activities have been taken over by the towns themselves. That the housing conditions around the open pit mines are very bad is universally acknowledged. These mines are always being extended so that the workmen who build little shanties close to the pits at the mining "locations" have to move repeatedly. The companies are unwilling to invest much capital in such temporary structures, and the people find it inconvenient to live in the towns a half mile or more away. Bad housing conditions are claimed to be one of the causes of the great amount of tuberculosis found among the Finns in these shifting towns. One can picture the transiency of the "locations" when one realizes that the whole city of Hibbing (population about 9,000 in 1919), with its paved streets, brick public buildings, and business blocks, is being moved away *en masse* to allow for open pit mining under its site. Already the enormous crater of the mine yawns close to the heart of the business section. The mining companies on the copper range, where a mine mouth is fixed for many years, have provided good houses for rent for most of the workmen. There are, however, conditions of overcrowding there also. These

towns have public water supplies either from lakes or deep driven wells, and complete sewerage systems. Other public health activities are but little developed. The reasons for this can perhaps be found in the so-called "contract system" of industrial medicine, so widely used on these three ranges. This system is said to have been imported with the Cornishmen in the early days of the development of the copper mines in Michigan. It was claimed to be impossible to keep doctors in the newly opened mining regions unless incomes were assured them. The system has been employed on each of these three ranges in turn, as they have been opened to development. The Mesaba range gave excellent opportunities to study the system from all angles of approach, including its effect on community health work, and is, therefore, the first one to be described although, in order of development, it is the most recent.

Since one object of the contract system is to assure an income for the private physician who practises on the range and so takes care of the miners, the companies have employed the arbitrary system of deducting, for this purpose, a certain amount each month from the pay envelope of the employee. The amount has varied with the years, with the companies, with the towns, and with the marital condition of the employees. In general, it may be said to range from 75 cents to \$1.50. It is one of the conditions of employment, and the workman has no choice about it. The industrial contract doctor today gets altogether from \$1 to \$2 a month for every man employed by the companies for which he acts as contract surgeon. He takes his chances on the fluctuations of the number employed. Some years he loses and some he gains.

In the days before compensation laws were known, an additional amount of 25 cents a month was deducted from the pay envelope for a sick benefit fund, which paid \$1 a day benefit for two to three months; but since the employer has been made responsible for accident care and compensation, this deduction has been stopped by most companies, although payments from accumulated funds in a few treasuries are still going on. Before the compensation act, the deductions were the only guaranteed income for the doctor. Since its introduction, the mining companies pay in addition from 30 to 50 cents per man per month to cover accident treatment, for which they are responsible in the eyes of the law.

In addition to the benefits mentioned above, most of the foreigners — "Austrians" especially — belong to their own societies, sometimes secret, which pay sick benefits. One of these (membership 175 and dues \$2 a year) pays a sick benefit of \$1 a day. It contracts, for \$1 per member per year, with a doctor who gives medical service to members only. We were repeatedly told that some of these men belong to so many societies that when they are ill or injured they receive more money per day than when they are working.

What are the responsibilities which the doctor undertakes when he accepts this fee from the company? Accident care, of course, including hospitalization, if that is needed, free medicines, medical and hospital care for the man and his family, including obstetrical services, are part of the responsibility. Dental care is not included, nor fitting the eyes with glasses. For all but the first two, there are small additional charges made for board in the hospital, for operation or conditions arising outside of the line of employment, and for obstetrical care (\$5 to \$10). To meet these obligations, the physicians in nearly all cases have equipped their own hospitals, so that in towns of from 8,000 to 10,000 population as many as three hospitals of twenty to thirty beds each is not an uncommon

sight. Most of these are old houses which have been adapted to hospital uses, but one was a new fireproof building constructed for this special purpose. One of the companies is building a large hospital which will be rented to its contract surgeon. Most of the hospitals are well equipped with X-ray machines, good operating rooms and laboratory facilities, though the state department of health does a great deal of this work for them. Each hospital has its own pharmacy for distribution of free medicines.

The contract surgeon in all cases employs one or more young assistant doctors and nurses for hospital work, but not for home visiting. There are no internes such as are found in hospitals in other communities. On this range, the doctors do most of their work through home visits, and have developed dispensary methods but little. The tendency among the best contract surgeons is to develop specialties by employing specialists, such as surgeons, laboratory technicians, oculists. Only a very few companies have new men examined before employment, and then for the purpose of elimination, in most instances. There were one or two striking examples of doctors with a vision of the broader purposes of these physical examinations. The prevailing sentiment among industrial managers and contract doctors seemed to be that corporations on this range fear to inaugurate physical examinations because of the opposition which they might arouse among the laboring class. There are no unions on any of the three ranges, although there have been severe strikes in the past few decades when labor has attempted to gain recognition of the right to collective bargaining. At present the open shop and "suppression of unionism" principles prevail.

The contract surgeons take private patients, also, at the rates established by the Mesaba Range Medical Association.

Prescriptions	$1
Consultation at office	2–10
House visits (7 A.M.–10 P.M.)	3
Mileage per extra mile over a stated district	1
Night visits	4–5
Consultation visits	5–25
Minor surgical operation	5–50
Reduction of fractures and dislocations	50–100
Confinement cases	25–50
Operation for tonsils and adenoids	25–50
Major surgical operations	100–500

In the larger towns of this range, there are also doctors practising privately who are not contract men. Their clientele is drawn chiefly from among the merchants, clerks, and farmers. A number of the doctors are Finnish. The contract men are American trained and usually of British descent. The population per doctor in two of the Mesaba range towns is only 500. Since the chief industries here are mines which employ the immigrants, the greater proportion of the foreign population comes under the contract system. The railroads and lumber companies have similar arrangements for their men. These three industries are practically the only ones on this range. In a number of towns, the municipal employees are under the contract system, also, by their own request.

On the Vermillion iron range at Ely the financial arrangements are much the same, though perhaps the rates are a little higher. There are no doctors in the town other than the contract men who do private work also. These men are located at the one hospital which is there, and take care of most of the mining work on this range. The municipal employees come under the system likewise.

On the copper range in Michigan, the financial arrangements differ slightly from those on the other ranges. The physicians are employed by the mining companies on salaries, and the hospitals are either built by the companies themselves, or else dispensaries are maintained and use is made of community hospitals. Fifty cents to $1 a month is deducted by the companies from

the pay envelopes of the miners. The doctors perform the same services as they do on the Mesaba range, except that here they lay emphasis on dispensary work rather than on home visiting and hospitalization. One of the big companies, employing about 4,000 men, has an average of ninety outpatient visitors a day. Prescriptions filled at the hospital drug store amount to 80,000 a year. In peace times, there are nine doctors on the staff, all full-time men. The thirty-bed hospital has six trained nurses and eleven student nurses. Obstetrical care is free, except for a nominal charge for board. The sickness benefit fund, here known as the employees' aid fund, is supported by monthly deductions from the pay envelopes of 25 cents or more. Before the days of accident compensation laws, the company used to put into the fund each year as much as the men, but that has now ceased. In war time the aid was $1.50 per day, but in normal times it is $1. The fund is administered by the company.

One of the industrial physicians on this range is laying stress on dispensary work and home visiting with the aid of nurses. His tendency is to develop the work into preventive medicine rather than to keep it entirely in the treatment stage. For hospitalization, he uses a private hospital in the town. He examines all new employees for the purpose of placing them where they are best fitted to work, and does not simply eliminate the unfit. The men are not unionized on this range either, but, according to this doctor's testimony, there is very little objection on the part of the men to the examination, and if the men thoroughly understand its purpose, he believes they never will object. "To my mind," said our interviewer, "the delightful and sympathetic understanding of the workman's viewpoint, which this very exceptional doctor possesses, accounts for the men's attitude towards his work."

Opinions as to the value of this contract system of industrial medicine differed widely, depending on whether the person interviewed represented the employee or the employer. Representatives of the mining companies generally seemed to regard the system as "welfare work." This was also the point of view of most of the contract surgeons. They felt that they were doing good to a helpless and ignorant group of foreigners who would suffer greatly if the system were dropped. That the employees were compelled to finance the scheme under company administration seemed to most of them perfectly just. There seemed to be some question on their part as to the companies' continuation of the system, the reason for which probably lies in the attitude of the workmen toward it.

Many of the miners apparently give no thought to the system, but accept its advantages without question. There are many, on the contrary, who regard it as one of the righteous causes for the labor unrest that is to be found on these three ranges. The presence of such large numbers of Finns in this region is an important factor to consider in estimating their reception of the system. They have been radical socialists in Finland for many years as a consequence of the long struggle for freedom from Russian injustice. The "Reds," who are the radicals, and the "Yellows," who are more moderate, come to these mining regions where they find in the autocratic management of the industries new fuel for their propaganda.

The one-sided method of support of the contract system, autocratic administration of funds, and lack of choice of a doctor are a few of the things which serve to fan the flame of protest against the contract system. Accusations of a poor grade of medical care were also made. Some claimed that employees were hurried back to work before they were able to go. This remark

coincides very closely with that of some of the doctors, to the effect that, in order to justify their existence to the mining companies, it was necessary to keep men on their jobs. Only two of the contract surgeons regarded themselves as employees of the workmen. Since they are all responsible to the companies who engage and discharge them, their first effort is to satisfy their employers.

The contract surgeons held varying views as to the value of the system. Some thought it was an excellent thing for all concerned, offering exceptional opportunities for medical care in a region which would be very badly off without it. Others regarded it as a means of receiving an assured income with a minimum amount of work. The first group was made up of the progressive men who were trying to develop the very best of medical service. Some bore the same relation to the employees that the family physician bears to his patients in private life. All but one were agreed that they were obliged to do much unnecessary work because the men tended to abuse their right to free medical care and drugs. The second group consisted of the commercial type of industrial doctor who required other incentives to good work than service to the families entrusted to his care. With financial competition eliminated, such men retrograde, and the employees suffer in consequence.

Foreign doctors practising privately and in no way connected with the mining companies seemed to feel that if properly directed and democratically organized the system would be a benefit to their countrymen. Their other criticisms were much the same as those of the workmen. By them also the present arrangement was felt to be one of the causes of the strained relation between the companies and the employees, which could be felt on all three ranges.

Community health work on these ranges, where this system of industrial medicine is so universally used, is only slightly developed. Since other municipal functions, like the schools, are so advanced, the unequal development of the contract system and the city health departments seems more than a mere coincidence.

The Mesaba range again offers the best chance to study this relationship. In most of the towns here, the health officer is a part-time man, frequently the chairman of a board of health as well as a contract surgeon, and occasionally a privately practising physician in addition. His chief public function is to take charge of the contagious hospital, if the town has one; if not, he supervises contagious diseases in the homes. Charity sick cases are turned over to the county "poor doctors." Vital statistics are supposedly kept by the health officers, but with the exception of one or two towns the records are very incomplete, and have never been analyzed. None of the boards has even issued an annual report. These men are paid \$100 to \$200 a month. There are a few towns which are making real efforts to secure an up-to-date health department, but only one of those which I visited had a doctor who acts both as health officer and school physician, and gives his whole time to the work. His salary is paid by both the school and health boards. Last year, his department received an appropriation of \$20,000 in a town of 9,000. This was the only town really able to do progressive work, since the part-time men are too handicapped by other responsibilities.

A number of the towns employ a "city nurse" who does all sorts of miscellaneous work, such as follow-up of tuberculosis, care of charity cases, attending to isolation of contagious diseases. She is always a full-time nurse. The only other home nursing facilities in these towns are the school nurses.

The public schools on these ranges, particularly those in Minnesota, are the

most highly developed of all the municipal responsibilities. Most of the schools are provided with doctors and nurses, and one town (Buhl) has employed a school dentist until very recently. It is their aim to examine all pupils at least once a year, although the war has greatly interfered with the attainment of this ideal. Eye specialists are brought from Duluth whenever there are enough children in need of treatment to justify the expense. Dental needs are largely uncovered, although a number of towns are intending soon to employ dentists for schoolchildren. Physical defects are followed into the homes, and attempts made to have them remedied, usually through the contract surgeons who have the care of the families. Some of the school doctors remove tonsils and adenoids, and some are able to fit simple glasses. Very little health educational work is done except incidentally. For instance, one doctor distributed monthly health leaflets to the teachers for work with their classes.

Perhaps the most wide-spread public health education in the schools was furnished through the weekly and daily baths given at the schools to the children who needed them. The buildings are nearly all equipped with showers for this purpose. The nurses claim they can detect some influence in the homes of this kind of education and of the example of the exquisitely clean toilet fixtures to be found in all the school buildings.

Of private health organizations other than the secret societies and contract surgeons, there are none locally. The county and state tuberculosis associations and the infantile paralysis department of the state board of health are at work in these towns. The range is inadequately supplied with dentists, there being one to about every 2,500 or 3,000 people, and none in public employ. Union dentists, a syndicate type of organization radiating its work from Duluth, are to be found everywhere. They advertise extensively bridge work and crowns — work which is sent to Duluth to be done.

Midwives are to be found in all the towns, but they do not play an important rôle in the medical situation. Some are Austrians, a few are Finns, a few Scandinavians, but there seem to be no Italians. The kind of services given varies from housekeeping, in addition to delivery, to purely obstetrical work, depending on the degree of skill or training. Most of these women are of the "practical" type, or of the type known as "neighborhood women." One Finnish midwife, who is a graduate of a European school, had a reputation for doing very good work. The rate charged varies also, but is usually \$10 or \$15. The ease and cheapness with which obstetrical care can be obtained through the contract surgeons seem to be factors in lessening the popularity of the midwives in these towns.

Chiropractors are omnipresent on the Mesaba range. The similarity in the appearance of their local advertising makes one suspect that there may be a commercial combination binding them all together. Itinerant oculists are occasionally seen at the hotels. Very rarely now do patent medicine vendors wander the streets as they used to do ten years ago. These types of medical quackery are much more prominent on the Mesaba range than on the other two ranges. It is the wealthiest one of the three and most recently opened, thus perhaps attracting this kind of "easy money" seeker.

The public health work on the copper range of Michigan is in a still less developed stage. The township of Calumet, for instance, has its own township government which is closely linked with that of the mining company there, flanked on either side by incorporated villages within the township limits, which grew up around saloons just outside the mine property, and

all of which together cover not more than a square mile. Both villages and township have their own separate officials, which means that there are three part-time health officers having jurisdiction within this small area. To produce unity of action in the influenza epidemic the state health department had to step in. There is no city nurse here, no school doctor, and no school nurse, although once there was one. A Finnish and a Russian doctor, as well as several native doctors, are practising here privately.

Dental needs are fairly well supplied, there being one dentist to every 1,500 population — a much better record than the Mesaba towns show. There are no union dentists. Chiropractors are present as usual, and occasionally patent medicine vendors are seen. On all three ranges, the Finnish, Scandinavian, and Italian newspapers carry their usual large amount of patent medicine and quack advertisements.

The system of industrial medical service in these mining communities of Minnesota and Michigan may be compared with that in other mining regions in the United States. Recent reports by Dr. Emery R. Hayhurst, made for the Ohio and the Illinois Health Insurance Commissions, show a marked contrast with the conditions in the northern states.

> Medical practice in mining centers in Ohio is maintained by a set of steady, hard working native American physicians, few of whom engage in contract practice. Fees charged miners are the same as those charged other members in the community. These rates do not vary much from one end of the coal field to the other, and are lower than in the rest of the state. In general, there is a shortage of physicians in mining districts which at times becomes acute because of the inaccessibility of the community. Trained and practical nurses are almost unknown persons in the mining districts. Diagnostic facilities are meager and most laboratory work is sent to the larger cities. If laboratory and hospital facilities were at hand, more scientific medicine could be practised in these districts (12).

The contract system is much less frequently used in these regions in Ohio than in Minnesota and Michigan. Dr. Hayhurst refers to medical quackery, which he found flourishing. His conclusions regarding the mining regions of Illinois are similar:

> As is well known, contract practice for so-much-per-man-per-month is looked upon with disfavor by county medical societies. This feeling seems to be shared by the local unions also. As a result of this disfavor, contract practice is less extensively found than formerly in the mining districts. Of the fifty-three physicians interviewed, three maintained a contract practice on the basis of $1 per month per family, or 50 cents per month in the case of single men. . . . Housing conditions, community neglect, bad forms of recreational hygiene and especially alcoholism, undoubtedly constitute the chief causes of most sickness. This whole situation is due largely to the inadequacy of community health organization and prophylactic measures against diseases (13).

It is apparent that for one reason or another, probably largely because of the greater age and further communal development of Illinois and Ohio, the identification of the industrial medical service with the community medical service is much less complete than on the iron and copper ranges of Minnesota and Michigan. The proportion of foreign born is less in Ohio and Illinois. Dr. Hayhurst notes that organization among the workers themselves for protection against disease and death is much more frequent among the foreign born than among the native born. It is evident that the diminution of the contract system of practice in the mining regions of Ohio and Illinois has not yet led to an adequate development of community facilities for medical and health work. It is a fair question whether the almost complete identification of medical and health work with industrial medical service, as found in northern Minnesota and Michigan, is better or worse for the people as a whole than the conditions reported by Dr. Hayhurst in Ohio and Illinois. Without doubt, the control of medical practice by the mining corporations under the contract system on the iron and copper ranges in

Minnesota and Michigan raises a serious industrial question, or at least is one of the factors entering into local issues between employer and employee. The employees are taxed to bear the expense of a system of medical service without having representation which would enable them to share in determining its policies and administration. If this medical service were wholly within the industrial establishment, the issue would be less far-reaching than in mining communities where industrial medical service is practically all the medical service there is. When to the problems thus raised is added the further complication that a large proportion of the employees are foreign born, we have an important issue of practical policy. How far should the industry go in providing community medical service? How far should employees, particularly if foreign born, be given a share in the determination of this question, in financial support of whatever system is established, and in co-operation with its administration?

This question has been met in other mining regions on a practical scale. In certain mines of western Pennsylvania and of Colorado some approaches toward more democratic organization and management of medical service are already in operation among a population largely foreign born. These plans have, therefore, been described in sufficient detail to illustrate the methods employed and their value as judged by some of those who are directly concerned with them.

In the Monongahela Valley, Pennsylvania, the miners are chiefly Russians, Poles, Slovaks, Croatians, Hungarians, Lithuanians, and Italians. Consequently, the question of medical service in that region relates almost entirely to the immigrant workmen. This valley is strongly unionized, the eight-hour day prevails, and according to the testimony of the industrial managers "things are run pretty much as the unions please." On the day the valley was visited, the mines were shut down while the men had gone off to a central town to celebrate "John Mitchell Day" in commemoration of their securing the eight-hour workday. At this time, their slogan was "Six hours and more pay."

The town of 3,000 people, which was visited, is one of two towns close together owned by the same company. There were three mines, close by and within its borders, which were being run only part of the week, due to a slump in the market for coal. The coke ovens of the old open type, discharging poisonous fumes into the air, together with the smouldering dumps at the mine mouths, filled the atmosphere with smoke and gases. The half-dead appearance of vegetation in all regions where coke is made testifies to the hazard of health near these ovens. What the effect of this atmosphere is on human life and on little children, it would be difficult to overstate.

This town to all intents and purposes is owned by the company, which builds the houses, supplies light and heat, keeps up the streets, etc. The town government and company management are practically synonymous terms. No saloons are allowed in either of the two towns, although intoxicating drinks can be secured a few miles away. Drunkenness is the great curse of the Slavic miners of this region. The only doctors in the two towns are the three employed by the accident association of the company. One of these men acts also as health officer for the towns. The industrial medical service, which is the only kind available, is managed jointly by the miners through their unions and by the company. It serves the whole community as well as the miners themselves. The organization is known as the Employees' Death and Accident Association.

The object of this association is the establishment and management of a fund to be known as the E——

C—— Company Employees' Death and Accident Association. Out of this Fund, payments of definite amounts will be made to employees, contributing to the Fund, who under the regulations are entitled thereto in the event of their disablement by accident; also out of this Fund, provision will be made for the employment of doctors and assistants, for the furnishing of medical and surgical treatment of employees and their families, who, under the regulations, are entitled to receive same.*

The fund is administered by an executive committee composed of nine foremen, employees both inside and outside the mines, superintendents, the mine inspector, and the chief clerk of the company, who acts as secretary and treasurer of the association. "They investigate all claims for benefits, decide upon and direct all warrants that are to be drawn, and transact any other business — see that benefits are paid promptly and that the doctors render satisfactory service."

All employees are eligible to belong to the association, but membership is not compulsory. Non-employees living in the town can also belong, but pay $1.50 for a visit of the doctor. The dues are $1.25 a month for single men and $1.75 for married men, "collected semi-monthly from the payroll." The company donates $1,500 a year, and provides emergency hospitals and equipment in each of the two towns where their miners live, furnishing light and heat without charge. The head physician receives a salary of $350 a month and each of his two assistants $250 — salaries which are fixed by the executive committee.

Mine injuries are cared for by these doctors and all illness of members and their families. Medicines are free. For confinement cases and venereal diseases, there is an extra charge, that for the former not to exceed $5. When hospital care is required, the Mercy Hospital in Pittsburgh is used at the expense of the association. Sick benefit societies among the foreigners have the first examinations made by these doctors for $1 each. This money is turned over to the treasurer of the association.

There is an accident benefit attached to the association of $1 a day for six months, which is paid in addition to the compensation required by law. There are no sick benefits, however, except those connected with many fraternal organizations, such as the Moose and Eagles, and societies among the Poles and Lithuanians. Accident and death benefits of $300 are included, as the names of the organization would indicate. In case of natural death, a funeral benefit of $100 is allowed. The company employs a community nurse who works under the orders of the head physician of the association. The state pays the association for the services of its doctor each year to make physical examinations of the school children according to Pennsylvania law.

Since all the union leaders were away the day the company was visited, it was impossible to get their attitude toward this plan. The few employees whom we were able to interview spoke in highest terms in praise of it. The very fact that the unions are partners in its management tells its own tale of their consent. The doctor in charge of the work felt that it was "fine" for all concerned except for the physician. He voiced the old cry of the contract doctors that they were overburdened with unnecessary calls for minor ailments simply because their services were free. The one exception found to this general complaint was a physician in Michigan who was developing dispensary work as rapidly as possible. His desire was to get just as many people as he could to come to the dispensary for minor things, so that the really ill could be sorted out. His are the ideals of preventive medicine.

The Colorado Fuel and Iron Company of Pueblo has evolved a different system of industrial representation which affects health work in a most interesting way. It

* Regulations governing the E— C— Company Employees' Death and Accident Association, published by the company.

is generally spoken of as the Rockefeller Representation Plan, and is widely known. The underlying principle is representation of the humblest worker through the ballot in a committee form of organization. "Representation of employees in each camp shall be on the basis of one representative to every one hundred and fifty wage earners, but each camp, whatever its number of employees, shall be entitled to at least two representatives" (14).

Both in the steel mills of the company at Pueblo and in their chain of mines, the foreign-born workmen are present in great numbers, chiefly the Italians, Greeks, and Welsh. Thus many names such as Lucero, Blondo, Nacearatto, Morelli, Bevaqua, Ritz, Battiste, Lusik, and Keseric are to be found as signatories to the agreement made in 1915 between the company and the employees. These signatures mark the beginning of a new epoch for the immigrant employees of the company.

The details of the system cannot be gone into here, except as they relate to medical service and health work. Each of the five district conferences, in each of which there are present the president of the company or his spokesman and the elected representative of the employees, select four joint committees. "These 'joint committees' shall be available for consultation at any time throughout the year with the Advisory Board on Social and Industrial Betterment, the President, the President's Executive Assistant, or any officer of the Operating Department of the Company" (14, p. 9).

The committee on safety and accidents and the committee on sanitation, health, and housing are composed of six members each — three designated by the employees' representatives on the district conference, and three by the president of the company or his representative.

> The Joint Committee on Safety and Accidents may, of their own initiative, bring up for discussion at the Joint Conferences, or have referred to them for consideration and report to the President or other proper officer of the Company at any time throughout the year, any matter pertaining to the inspection of mines, the prevention of accidents, the safeguarding of machinery and dangerous working places, the use of explosives, fire protection, first aid, etc., etc.
>
> The Joint Committees on Sanitation, Health, and Housing may, of their own initiative, bring up for discussion at the Joint Conferences, or have referred to them for consultation and report to the President or other proper officer of the Company at any time throughout the year, any matter pertaining to health, hospitals, physicians, nurses, occupational diseases, tuberculosis, sanitation, water supply, sewerage system, garbage disposal, street cleaning, wash and locker rooms, housing, homes, rents, gardens, fencing, etc., etc. (14, p. 10).

In the selection of doctors to be employed by the company and employees in the future the workmen will have a deciding power. At the time the agreement was signed there were doctors already employed.

> In camps where arrangements for doctors and hospitals have already been made and are satisfactory, such arrangements shall continue. In making any new arrangement for a doctor, the employees' representatives in the camps concerned, the President's Executive Assistant, and the Chief Medical Officer shall select a doctor, and enter into an agreement with him which shall be signed by all four parties (14, p. 22).

It is hoped that in time this check will improve the grade of the medical service by weeding out the poorer doctors and that it will also give more satisfaction to the employees.

A brief description of the medical work now being carried on by the company will be necessary before discussing the relation of these committees to it. To support this activity of the company, all employees pay $1 a month. At Pueblo where the company has a large steel plant employing about 5,000 men, there is a 200-bed hospital owned by the company, which is excellently equipped with laboratories and

an X-ray outfit. The staff is paid and resident, with the exception of a few visiting men in the specialties who are paid for part time. Medical, surgical, and obstetrical services are the main functions of the hospital, but there are nose, throat, and eye departments, and also a dentist. This hospital service is free to all employees in Pueblo, and low rates are given to members of their immediate families. There is also a dispensary occupying a building by itself with two or three doctors in attendance. All applicants for work in the Pueblo plant are examined here, as well as men who have been absent over a pay day because of illness. The employees of the steel works are entitled to use this dispensary for any injury or disease. There is no medical care provided in the homes by the company in Pueblo itself.

In each of the thirty or more mining camps scattered through Colorado and Wyoming, a company doctor is provided who furnishes medical care, including medicines, for the employee and his dependents. Maternity services, care of venereal disease, and the results of fighting are excepted. A dentist travels from camp to camp, working chiefly with the children. It is hoped soon to employ another doctor who will act as school medical inspector for all the camps.

The joint committee on sanitation, health, and housing has a direct bearing on medical service, especially in the mining camps. The men who are selected to serve on it are paid $5.40 a day (the rate fixed by the representatives themselves) and expenses, regardless of their wages at the time of service. Automobiles are provided by the company for their transportation. The employees enjoy the opportunity to visit the different mines and regard the work as an honor. They make regular visits of inspection within their districts, spending two weeks out of every three months of service doing this. Such a system saves the company the employment of a large inspection force and stimulates the local boss, mine superintendent, and camp doctor to keep things in good condition. This naturally puts the men in charge of local conditions on their mettle to present a good appearance, and gives rise to healthy rivalry.

Because of the numbers of foreign born employed by the Colorado Fuel and Iron Company, the success of this system of representation is of interest. Officials of the company directly concerned with its trial state that it has been a wonderful factor in stimulating interest on the part of the workers. Not only do they notice conditions now, but they are given opportunities for self-expression. The result is an awakened consciousness of the part to be played by them in the promotion of better health for the miners and the securing of a more sanitary environment. The company officials also give testimony that the plan has value in giving opportunities for self-expression to all types of labor employed. Both from the financial viewpoint and in diminishing labor turnover and discontent, the system appears to them a paying proposition. When the polyglot character of the employees is considered, this success is still more significant.

Conclusions

Correspondence and conferences with industrial physicians, employment managers and others, have made it clear that relatively little attention has yet been given to the special medical and health problems presented to industry by the immigrant. A few individuals and establishments have begun to deal with certain of these problems but no very thoughtful and systematic work has yet been undertaken. This is true, despite the fact that the foreign born constitute a very large proportion of employees, particularly in many basic indus-

tries. Furthermore, the foreign born and their children are a majority of the entire population in many industrial communities, both large and small. In not a few of the middle-sized industrial towns and cities, the population is from 50 to 80 per cent. of comparatively recent immigrants and their children. The whole community life, in its health relationships as well as in other respects, is bound up with the problem of Americanization, and since in many of these smaller communities the only large and effective force is the industry itself, the responsibility of industry looms large. Its share in working out the medical and health problems of the community cannot be put aside, but it should act upon this responsibility in the right way.

It is also true that industrial medicine has been an industrial issue, not merely a matter with which the industrial physician and other technical workers have had to deal. In such major examples of economic welfare as the mining difficulties in Colorado in 1913 and 1914, the system of industrial medicine was very distinctly an issue. This is true today in many factories and mines, where the restiveness of employees under an ill-understood and little explained system of medical examinations or medical care is a stimulus to industrial unrest, and involves a diminution of the efficiency of the medical and health work for which the industry itself is paying out money.

The main conclusion from our survey of industrial medicine in relation to the immigrant is that industrial medicine, like other forms of medical and health work, ought to specialize in human relations as well as in medical relations. Where a large proportion of the employees are foreign born, knowledge and consideration of immigrant backgrounds and characteristics are essential if the medical service of the physicians and nurses is to give 100 per cent. value for its cost. The industrial medical men need to play in close relationship with departments that are growing up in many large industries, known as departments of industrial relations, etc., which are responsible for the development of satisfactory relations between employers and employees. Industry has so much more control over the employee while he is in the plant than the visiting nurse or dispensary social worker can usually acquire, that much larger results in curative and particularly in preventive medicine might be looked for if only industrial medicine were so organized as really to be understood by the employees, and therefore to enlist their hearty co-operation. The development of an industrial medical organization which will render this co-operation possible depends, of course, in large measure upon an industrial organization which, as a whole, establishes satisfactory relations between the employer and the employee. But industrial medicine can contribute toward this more effective industrial organization, or it can be a counterweight against it. Every effort to secure the participation of the employee in the support and the administration of industrial medicine should be made. The method of approach should be democratic and not paternalistic. The foreign-born employee offers special opportunities for the development of co-operation, because of the many societies to which such immigrants usually belong.

Some of the major questions with which industrial physicians and nurses are dealing are: the prevention of accidents; the prevention and, where necessary, the treatment of occupational diseases and of general disease; the maintenance and promotion of sanitation within the plant and of personal hygiene among the workers. Not a few establishments are also concerned with the food problem, since they maintain lunchrooms or restaurants. Now in every one of these six important problems, facing practically every department of industrial medicine in every industry,

successful work is greatly handicapped by the barriers of language and understanding between the immigrant and the native-born American. If the employers who are supporting industrial medical departments appreciated how much more efficient these departments would be made by proper knowledge of the technic of dealing with the foreign born, they would insist that their doctors and nurses acquire a modicum of this technic.

Industrial medicine must justify itself to industry on a business basis. The owners of industry, who pay for it, must feel that it pays them. The better the medical men they secure, the better it will pay, for one kind of industrial medicine that will never pay is the cheap kind. Really good physicians require adequate salaries. It is really good men who are more appreciative than second-rate men of the vital importance of human factors as an element in medical and business efficiency. It is the cheap man who conceives of and treats people cheaply. The keen, well-trained doctor is the one who will perceive and strive to deal with the special problems of the immigrant employee.

In this connection, it is well to note that the industrial physician should be directly responsible to one of the high officials of the plant, as the head of any major department would be. Only in that way will be realized the full value of the medical work as a practical contribution to business efficiency.

The larger problem of industrial medicine hinges upon the question, "How far shall industrial medicine go beyond the walls of the industrial plant itself?" Not a few industries have undertaken housing for employees, partly for sanitary and partly for other reasons. Medical care to employees in their homes, and sometimes to their families also, has been extended by some factories, in many mining communities and in some labor camps. To reach outside the industrial plant itself, visiting nurses have generally been the first resource. Sometimes the serious mistake has been made of using these nurses for other than their proper function. The employment of nurses as policewomen to hunt up absent workers and report on the reasons why they are away is a misuse of nursing, and reacts unfavorably both on the medical and health work and upon the general relations between employer and employee.

The entrance of industry into community medical care has been frequently observed to coincide with a low level of public health work in the same area. This is particularly true in regions where much of the community consists of foreign-born employees too recently immigrated to take much part in normal community activities. A marked contrast could be drawn between the conditions described on the iron and copper ranges in northern Minnesota and Michigan, where practically all the medical and health work is done by the industry for the community, and, on the other hand, the situation in Akron, Ohio. Several large industries in Akron have well-developed departments of industrial medicine, but largely through the efforts of one or more of these industries themselves the health work of the community under the city government has been advanced and assisted to a notable degree. Where industry has a far-sighted view instead of a short-range commercial one, industry will encourage community health work and not substitute industrial medicine for it.

The contract system as developed in the iron and copper ranges in Minnesota and Michigan is, in the main, a creature of the employer rather than of the community, and has the essential limitations of the manner of its creation. It is apparent that in a newly-opened country such a contract system will assure the employees and their families medical services which would usually be beyond their reach if the in-

dustry did not come forward. Physicians would be unlikely to move to a pioneer town unless guaranteed something by a responsible organization. The contract system of industrial medicine has also demonstrated its ability to provide hospital facilities which otherwise would often be lacking. It has doubtless been of assistance, when the medical service has been good, in promoting the health of employees, enhancing industrial efficiency, and keeping men on the job. But such a contract system shows almost everywhere the evils of any scheme of medicine which is on a commercial basis, and which has not developed with the understanding and co-operation of those who are the recipients of medical care.

The participation of the employees in support and in management, or at least in criticism, are hopeful signs, and further development in this direction is greatly to be desired. On the whole, except under pioneer conditions and for a temporary period, the development of industrial medical service outside of the industrial establishment itself must be regarded as an influence against Americanization in the larger sense, and against the more permanent interests of medical and health work of a community. If industrial organizations and, therefore, industrial medicine were wholly co-operative and democratic as between employer and employee, this might not be true. But under present conditions, it is to be hoped that medical and health resources will be developed and strengthened as much as possible out of community rather than out of industrial resources. Industry should do its share as a part of the community, but not more than its share. The initiative and self-dependence of immigrants and their families, and their understanding of the purposes and methods of medical and health work can be promoted only when they have responsibility and participation as citizens, rather than as passive recipients.

One of the leading industrial physicians of the country said in an interview: "Demands for improvements in medical service must come from the employees themselves. It is up to the industry to educate and guide by virtue of the trained minds which it can employ, but not to superimpose medical service upon the indifference of the employees."

"Workmen should be allowed to develop themselves," says another industrial physician of an important national corporation, "and industry should aid only in educational work."

Mr. Whiting Williams of Cleveland, in an article printed for circulation by the United States Department of Labor (15), says: "The price of maximum production is maximum personality for every human producer. Of this, the price is maximum outlet for that human producer's best and biggest feelings. That in turn can be bought only with right relationships and associations with all the persons of his world. Of that the price and the prize is democracy."

BIBLIOGRAPHY

1. Jenks and Lauck: The Immigration Problem. 1917 edition, p. 148.
2. Sixty-First Congress, Second Session, 1909. Senate Document, Vol. 78.
3. Population. Thirteenth Census of the United States, 1910, Vol. 1, 307.
4. Knoeppel, C. E.: Industrial Organization as It Affects Executives and Workers. Address before American Society of Mechanical Engineers, New York, Dec., 1918.
5. Selby, C. D.: Studies of the Medical and Surgical Care of Industrial Workers. U. S. Pub. Health Ser., Pub. Health Bull. No. 99, Washington, 1919.

6. Mock, H. E.: Industrial Medicine and Surgery — A Résumé of its Development and Scope. Jour. Indust. Hyg., 1919, **1**, 1.
7. Roberts, P.: The New Immigration, 1914, p. 134.
8. Leiserson, W. M.: Labor Camps in Wisconsin. Report of Industrial Commission of Wisconsin, 1913.
9. Price, G. M.: Industrial Medical and Dental Clinics in the Women's Garment Trades. Mod. Med., 1919, **1**, 49.
10. Harris, L. I.: The Labor Sanitation Conference: How Workers Have Organized a Movement for Industrial Sanitation. Month. Bull., N. Y. City Dept. Health, 1917, **7**, 61.
11. Geier, O. P.: The Human Potential in Industry. Address before American Society of Mechanical Engineers, May, 1917, p. 13.
12. Hayhurst, E. R.: Health of Ohio Coal Miners. Report of Ohio Health and Old Age Insurance Commission, Feb., 1919, Appendix D, p. 382.
13. Hayhurst, E. R.: Health of Illinois Coal Miners. Report of Health Insurance Commission of State of Illinois, May 1, 1919, pp. 396, 400.
14. Industrial Representation Plan, Colorado Fuel and Iron Company, p. 4.
15. Williams, W.: Human Relations in Industry. Leaflet printed by U. S. Dept. Labor, 1918.

THE ANTHRAX PROBLEM IN HORSEHAIR*

HENRY FIELD SMYTH, M.D., Dr. P.H

Assistant Professor of Industrial Hygiene, School of Hygiene, University of Pennsylvania

THE question of the dangers of anthrax infection in industry from the handling of hides, wool, and hair is one of increasing importance in this country and the study of reports appearing from time to time in medical literature seems to indicate a growing menace in this respect, at least from the handling of hides and hair. Up to the present there seems to be little infected wool handled in the United States though the fact that there must be some danger from that source is shown in the report by Osborn (1) of 7 cases of anthrax in Massachusetts from 1917 to 1919 among wool handlers, 4 of them traceable to wool from Argentine, S. A., 1 to wool from Mexico or Argent. e, 1 to wool from the United States, and 1 to wool of unknown origin. Five of the cases were in wool sorters and 2 in wool salesmen. (Crediting the cases to material from different sources is not quite clear in the article as it is stated that "in a few cases material from two or more countries had been handled" but just which cases these were is not mentioned.) The same report tabulates 89 cases in the leather industry, 5 from handling domestic leather and 9 in the horsehair industry or traceable thereto, 1 of these being a handler of domestic hair.

Rural Anthrax

That anthrax is well established in this country as a rural disease is shown by a study of the Census Bureau mortality statistics (2) from 1911–1918 which show a gradual increase in the yearly total of fatal cases of anthrax in rural districts. (See Table 1.) Table 2, a compilation of the census statistics with those given in the recent anthrax bulletin issued by the Bureau of Labor Statistics (3), shows that, in the ten years from 1910–1919, there occurred 102 deaths from anthrax in the rural districts of twenty-six states, an area extending from Maine to California and from Washington and Montana to Texas and Louisiana. This being the case, are we justified any longer in assuming that

TABLE 1.—DEATHS FROM ANTHRAX IN THE RURAL PART OF THE REGISTRATION AREA, 1911–1918

Year	1911	1912	1913	1914	1915	1916	1917	1918
No. of Deaths..	5	7	13	5	15	10	19	22

domestic hides and hair are not liable to infection, as is done by the Department of Agriculture in its regulations requiring disinfection of suspected materials? Many of the states, it is true, have laws requiring the prompt burning or burying of the unopened carcasses of stock dying of anthrax, but that this is not always done is shown by a study of the histories of many of the cases reported in the Bureau of Labor Statistics bulletin. At least seven of the cases reported were contracted from skinning dead animals and one farmer even "opened a cow to ascertain the cause of its death and found in its abdomen black spots which he dissected" (3, p. 78). In the *Journal of the American Medical Association* for August 7, 1920, King (4) reported two cases of anthrax in Illinois contracted from skinning a mule, the hide having been sold before the diagnosis was made. This shows the possibility of infected materials entering commerce in spite of laws to the contrary and without purposeful evasion of the law.

* Received for publication Nov. 17, 1920.

Government Regulations

It is well known and has been frequently proved bacteriologically that anthrax-infected hides and hair are being continually imported from foreign countries in spite of regulations of the Department of Agriculture intended to prevent this from happening. The Department of Agriculture (5) forbids importation of hides from countries where anthrax is known to be endemic, unless from a country maintaining efficient veterinary inspection, and accompanied by a consular or veterinary inspector's or other authorized official's certificate stating either that the materials have been "properly disinfected" or that they come from an area at the time free from anthrax. Osborn (1, p. 663) points out the impossibility of a consul or importer in all cases assuring himself of the fact of freedom from anthrax or of even being sure of the source of the bales offered for export. Wool and hair for importation must merely be "accompanied by an affidavit of the exporter . . . stating that all the wool or hair . . . came from animals free from anthrax" provided the consignee agrees to "disinfect" by exposure to 165° F. Apparently no consular or veterinary certificate is required (3, p. 151). If unaccompanied by such certificate, materials may be imported provided they are disinfected as soon as they are opened up at the factory where they are to be used. This offers no protection to the stevedore or freight handler and cases of anthrax among such men are not unusual, a number being reported in the articles referred to above. The Department of Agriculture provisions for disinfection of hair seem woefully inadequate to anyone who has done much laboratory work with anthrax spores. They require for horsehair "proper exposure to a temperature of not less than 200° F. for at least fifteen minutes, or in such manner as may be directed by the Chief of the Bureau of Animal Industry." The last saving clause does not apply, however, to hair "disinfected" before shipment to this country, and there is no provision in this ruling even for the opening up of the bales to afford penetration of the heat.

TABLE 2. — DEATHS FROM ANTHRAX, TRACEABLE TO RURAL OCCUPATION, IN THE UNITED STATES FROM 1910 TO 1919 *

Area	State	Deaths per State	Deaths per Area
New England......	Maine	1	9
	Vermont	2	
	Massachusetts	1	
	Connecticut	5	
Mid Atlantic......	New York	14	37
	New Jersey	4	
	Pennsylvania	17	
	Maryland	1	
	Virginia	1	
Southern...	Louisiana	4	11
	North Carolina	3	
	South Carolina	2	
	Texas	2	
Central..........	Ohio	3	22
	Kentucky	6	
	Indiana	4	
	Kansas	2	
	Missouri	4	
	Wisconsin	1	
	Michigan	2	
North Western	Minnesota	2	5
	Montana	1	
	Washington	2	
Western..........	Colorado	5	18
	California	12	
	Utah	1	
Total...........	26 states	102	102

* Tabulated from reports in U. S. Census Bureau mortality statistics for 1918 and in Bulletin No. 267, U. S. Department of Labor, Bureau of Labor Statistics.

That the provisions of these rules do not adequately protect workers in this country is shown by the fact stated by Osborn (1, p. 658) that "this [consular] certificate was given in the majority of hide shipments

that apparently infected hide handlers in Massachusetts," and by the further facts that virulent anthrax has been cultivated from dressed hair imported from China, obtained in a hairdressing factory in Philadelphia, that the New York City health authorities * state that they have found anthrax in 75 per cent. of such dressed hair shipments from China, and that there were recently five deaths from anthrax in Chicago in a curled hair factory, presumably from handling Siberian hair (6). The numerous cases of facial anthrax traceable to infection from horsehair shaving brushes are further evidence of this fact, as many of these brushes have been made from Chinese hair.

Horsehair Dressing

In view of the above facts, and at the request of the hairdressers' union, the Pennsylvania State Department of Labor has conducted an investigation of the horsehair industry in Philadelphia, the center of hairdressing in this country. During this investigation, the author and a representative of the Division of Hygiene of the State Department of Labor visited twenty horsehair dressing shops, a haircloth weaving factory, a curled hair factory, a brush factory, and brush hair and bristle reclaiming shop. Most of the hairdressing shops are small plants with from two to six workers, the proprietors usually dressing hair themselves. The shops, with a few exceptions, are dirty and cluttered with horsehair, dust and litter being very much in evidence through the entire plant. Undressed hair is received in bundles or large bales and there is no provision for separate storage of washed and disinfected hair and suspected imported hair. Hair is collected from all over this country and from Canada, the bulk of the hair coming from Canada being so-called "live hair" or combings from live, presumably healthy horses, while practically all the hair from the United States is cut from carcasses or hides, much of the tail hair being received on the salted stumps. Some hair is washed at the point of collection and some is shipped unwashed. The proprietors claim that they wash all unwashed hair before dressing but workers stated that much is dressed unwashed. We ourselves have seen combings being handled without washing. The routine method of washing is to soak large lots of hair in wash-tubs or barrels overnight in soda solution made with hot water, but not kept hot, and in the morning to scrub the hair on a wash-board in hot soap or soapine solution, rinse, and dry either in a closed room heated by a small coal stove or on racks in the open in good weather. Hair received from infected areas, according to the present requirements of the Bureau of Animal Industry inspectors, must be so washed and then dried at 200° F. for twenty-four hours or more. This offers no protection to the washer or anyone who handles the unwashed hair.

There are three processes in hairdressing. The first process is "hackling" or combing out tangles, straw, etc., from the loose hair by throwing handfuls of hair over banks of stationary, pointed steel teeth and then pulling away all that will come. Frequent repetition of this process eliminates short hairs and arranges the rest in parallel bundles tapering to a point. These bundles are then "drawn" to size by being fixed between two sets of steel combs, the hairs of different lengths being drawn out by means of a razor blade held against the thumb. Small bundles of hair drawn to size are then "finished" by further combing, trimming and tying ready for shipment to the haircloth weavers or brush makers. Hackling is a dusty job when unwashed hair is handled, but dust is lessened somewhat

* Verbal communication from Dr. S. D. Hubbard, Division of Industrial Hygiene, Department of Health, New York City.

with all except white hair by the use of a little coal-oil on the hackling pins. The results of several dust determinations made with the Palmer dust sampler give an idea of the amount of dust produced in this

TABLE 3. — DUST DETERMINATIONS WITH PALMER DUST SAMPLER IN HAIRDRESSING ESTABLISHMENTS

Factory	Process	Hair	Amt. of Dust in ½ Standard Unit Particles per Cubic Foot
L. H.	drawing	unwashed domestic	1,000,000
L. H.	hackling by open window	unwashed combings	1,000,000
W. K.	hackling	washed black domestic	617,000
S. Z.	hackling	bleached white hair	260,000
	Average Count		719,250

process (Table 3). White hair is always clean and free from dust as it is routinely washed twice and bleached before dressing (see Table 3). No more dust samples were obtained as the majority of the workrooms were not equipped with electricity and so the Palmer apparatus could not be used.

Sampling and Testing for Anthrax

Samples of hair were collected in numbered sterile test-tubes and taken to the laboratory for bacteriological examination. There were collected 53 samples of undressed domestic hair; 9 samples of Canadian hair, and 20 of Canadian combings, all undressed; and 22 of undressed foreign hair — 4 from Australia, 6 from Argentine and 12 from Siberia. In all, 104 samples of undressed hair were examined and 13 samples of dressed hair from China. Of the undressed hair, 54 samples had not yet been washed and 50 had been washed. There was no record as to the washing of the Chinese hair but presumably it had been washed in some way before dressing. (See Table 4.)

The routine procedure of examination was as follows: Samples when brought to the laboratory were covered with sterile nutrient bouillon and incubated for twenty-four hours at 37° C. Then serial agar plates were poured from each sample and at the same time a subcutaneous inoculation of 1 c.c. or more of each sample was made into a guinea-pig. Plates were incubated twenty-four hours at 37° C. and then examined for anthrax-like colonies, using the

TABLE 4. — SAMPLES OF HAIR COLLECTED FROM TWENTY-FOUR SHOPS IN PHILADELPHIA HANDLING HORSEHAIR

Source of Hair	Kind of Hair	Stage of Manufacture *	Condition of Samples: No. Unwashed	Condition of Samples: No. Washed When Purchased	Condition of Samples: No. Washed in Shop Where Collected
U. S.	horsehair	undressed	13	21	15
U. S.	cow tails	"	2	. .	2
Canada	horsehair	"	5	4	. .
Canada	combings	"	18		2
Australia	horsehair	"	4	. .	. .
Argentine	"	"	4	. .	2
Siberia	"	"	8	. .	4
China	"	dressed	. .	13	. .
Total			54	38	25
Total U. S. and Canada			38	25	19
Total foreign .			16	13	6

* The total number of samples examined was 104 undressed and 13 dressed.

technic suggested by W. A. Hagan of Ithaca (7). Any colonies showing typical curling with long, regular, parallel threads usually returning to the colony mass, with few free ends visible, no spores in twenty-

four hours, individual cells distinguishable with difficulty, and with no motility visible in any part of the colony, were transferred to agar and saved for further study. According to Hagan, such colonies are almost sure to be true anthrax, and anthrax colonies always have these characteristics. His statement is based on the study of plates from eighty-five suspected samples, giving seventy negatives and fifteen positives confirmed by animal inoculations. Any guinea-pigs dying after inoculation were autopsied and smears examined from the local lesions in the subcutaneous tissues, the heart blood, the spleen, and the kidneys. Agar slants were made from the heart blood and bouillon cultures from a bit of the spleen. When Gram-positive aërobic rods were isolated, even if no typical postmortem lesions were found, subcultures in bouillon were inoculated in other guinea-pigs or in white mice, to determine whether or not the organisms were attenuated strains of anthrax. A similar plan was followed with any cultures from anthrax-like colonies on agar. From the entire series of tests but one typical virulent anthrax culture was isolated. It was passed through two guinea-pigs, producing typical lesions in each. This culture was obtained from one of the samples of Chinese hair. Three other samples of Chinese hair, obtained on the same day from the same shop, gave typical colonies on agar but failed to produce typical lesions in guinea-pigs. The same was true of one sample of domestic hair and one of the Canadian hair. Organisms were isolated from the heart blood of three other guinea-pigs, which, while not giving typical colonies or producing typical lesions, were present in such numbers in pure culture that they were injected into other pigs. Two of the three passed through the second pigs without producing typical lesions and failed to produce anthrax lesions in mice, so were not classed as anthrax.

When summed up, the results showed virulent anthrax in one sample from one of three shipments of Chinese hair and possibly avirulent anthrax in three other samples of the same shipment, and possibly avirulent anthrax in one sample of Canadian and one of domestic hair. The organisms designated above as possibly avirulent anthrax can only be so classed provided that Hagan's method of differentiation is reliable. Personally the author prefers to say that they were probably not true anthrax, and that while Hagan's method will probably correctly exclude all organisms not giving typical colonies, yet it is merely an excellent method of exclusion and not a certain means of positive diagnosis.

Disinfection Tests

Following the collection and culturing of samples of hair, a series of tests were carried out on the disinfection of horsehair impregnated with anthrax spores. For these tests forty-eight hour mixed bouillon cultures from the one virulent stain isolated, together with an anthrax organism previously isolated from a soak vat in a Philadelphia tannery, were used. Three samples of loosely matted undressed hair were placed in small Erlenmeyer flasks and sterilized in the autoclave for thirty minutes at 15 pounds pressure. Subsequent cultures showed a tremendous reduction in the number of colonies developing, but not complete sterility. (See Table 5–A.) A bundle of dressed hair, 6 inches long and 3 inches thick at the butt, was sterilized in the same way at the same time with a similar result, the samples for culture being pulled from the center of the bundle.

These autoclaved samples were then inoculated with anthrax — the flasks, by pouring 3 c.c. of forty-eight-hour anthrax bouillon into each and the bundle, by injecting 5 c.c. of the same bouillon into its

center by means of a long needled syringe plunged in at four different levels. The bundle was then resterilized in the autoclave for thirty minutes at 15 pounds pressure and thereafter no anthrax colonies

an open Petri dish in an electric drying oven for 48 hours at 200° F., samples being plated therefrom at intervals of 15 and 30 minutes, 1 hour, 2 hours and 24 hours, and after 48 hours the remainder of the sample

TABLE 5. — RESULTS OF DISINFECTION TESTS ON HORSEHAIR IMPREGNATED WITH ANTHRAX SPORES

A. Horsehair Subjected to Steam Sterilization

Material	Results of Treatment	
	Unsterilized	Autoclaved at 15 lbs. for 30 min.
Undressed loose hair	10 short hairs plated in agar gave innumerable anthrax colonies	10 hairs gave 6 colonies
Dressed hair bundle (6 in. long, 3 in. thick at butt)	4 hairs plated in agar gave innumerable colonies	4 hairs gave 42 colonies
Sterilized hair bundle inoculated through center with 5 c.c. anthrax broth	4 hairs gave innumerable colonies	no anthrax colonies in any of 12 plates containing 4 to 8 hairs

B. Horsehair Subjected to Dry Heat of 200° F. (93 + °C.)

Material	Time of Exposure to Heat					
	15 Min.	30 Min.	1 Hour	2 Hours	24 Hours	48 Hours
Sterile undressed hair infected with anthrax broth	4 hairs abundant growth	4 hairs abundant growth	4 hairs abundant growth	4 hairs abundant growth	10 hairs no growth	50 hairs no growth

C. Horsehair Subjected to Washing

Material		Results of Successive Steps of Treatment			
		Allowed to Stand in Hot 10% Na_2CO_3 Sol. for 18 Hours	Scrubbed in Hot Soap Sol. 10 min. and Rinsed in Hot Water †	Incubated in Drying Oven at 175°F. (79 + °C.) 24 Hours	Incubated in Drying Oven at 175°F. (79 + °C.) 48 Hours
Sterile undressed hair infected with anthrax broth	Sample 1	4 hairs in agar * numerous colonies	4 hairs in agar no anthrax	4 hairs no anthrax	50 hairs 1 anthrax colony
	Sample 2	4 hairs in agar 2 anthrax colonies	" " " "	" " " "	no anthrax " "
	Sample 3	4 hairs in agar no anthrax	" " " "	" " " "	" " " "

* Broth culture from agar plate of Sample 1 killed a guinea-pig in three days.
† Agar and broth cultures from soap solution after washing showed no anthrax.

were found in agar plates from twelve different samples, of four to eight hairs each, pulled from the center of the bundle. (See Table 5-A.)

From one of the inoculated flasks a loose bunch of hairs was fished out and placed in

was covered with agar. On incubation for twenty-four hours and subsequent observation for four days, the following results were obtained. (See Table 5–B.) Abundant anthrax developed after 15-minute, 30-minute and 1 and 2-hour exposures, but no

colonies of any type after 24 and 48-hour exposures to 200° F., showing the efficiency of the Department of Agriculture temperature requirements, provided the hair is loosely matted and the exposure continued for 24 hours, but, as was to be expected, the absolute inefficiency of 15-minute exposure.

The method of washing the hair, as described above, was tested with the balance of the hair in the inoculated flasks. The hair in each flask was covered with a hot 10 per cent. sodium carbonate solution. The flasks were then placed on a water-bath for eighteen hours (overnight), the solution in one of the flasks registering 55° C. in the afternoon and 68 °C. the next morning. Subcultures at this time showed anthrax in two of the three flasks, a broth culture from a colony obtained from one flask killing a guinea-pig in three days with typical lesions. The soda solution was then decanted and the hair covered with a strong hot solution of ivory soap, scrubbed vigorously for ten minutes with a glass rod and then rinsed with boiling water until the rinse water came away clear. Cultures from the decanted soap solution failed to develop anthrax. The rinsed hair was next transferred to open sterile Petri dishes and placed in the drying oven, which registered 175° F., and dried for forty-eight hours, cultures being made after twenty-four hours and forty-eight hours. No anthrax developed in any of the three twenty-four-hour cultures and but one colony in one mass forty-eight-hour culture. (See Table 5–C.) This shows that the method of soaking and washing in alkaline soap solution is fairly efficient provided the alkaline solution is kept hot, which is rarely done. As mentioned before, however, the method fails to protect the washer.

British Regulations

Industrial anthrax has been a serious problem in England for some years. The dressing of imported hair is a much larger industry there than with us and they have been endeavoring since 1905 to cope with the problem of rendering horsehair safe for the workers. The 1905 regulations, in addition to detailed precautions as to handling and storing of suspected materials, dust removal, hygiene of the factories and of the workers, require that wool or hair from certain suspicious districts shall be "opened either after steeping in water or over an efficient opening screen, with mechanical exhaust draft, in a room set apart for the purpose, in which no other work is carried on." There are, however, no provisions for sterilization given in these regulations. In the 1908 regulations provision for disinfection is made as follows:

> Suspected material must be disinfected either by (a) exposure to steam at a temperature not less than 212° F. for at least half an hour of material so loosened, spread out or exposed as to allow the steam to penetrate throughout, or (b) exposure of material to such disinfectant under such conditions of concentration and temperature of the disinfectant, and duration and manner of exposure of the material to it, and otherwise, as are certified to secure the destruction of anthrax spores in all parts of the horsehair subjected to the process.

"Certified" means certified by the director of a bacteriological laboratory recognized by a corporation in the United Kingdom having powers to grant diplomas, etc., thus placing the burden of proof on the laboratory desiring to certify. Under this ruling the most frequently employed means of disinfecting horsehair has been by the use of a proprietory preparation called "cyllin" with a rated phenol coefficient of 11 (Rideal-Walker). This was first certified (1908) for use on condition of immersion of the hair in a 10 per cent. solution for one hour at 60° F., the large bundles being opened out. Later the certification was changed to require a 2 per cent. solution for two hours at 98° F. or one hour at 130° F. (1912).

In a personal communication to the author Dr. T. M. Legge, Medical Inspector of Factories, writes as follows:

Further experiments . . . have shown that anthrax spores can be cultivated and cause the death of guinea-pigs from anthrax in material treated on factory premises with cyllin. As, unfortunately, until the recent work on disinfection of wool [8] elaborated a completely satisfactory method of disinfection by (among other operations) the action of a 2 per cent. formaldehyde solution, no method of chemically destroying anthrax spores was known, the cyllin certificate has not been withdrawn. Recently this method has been found to be equally effective in the case of horsehair, and . . . a trial disinfecting station to treat material by the process named is in the course of erection at Liverpool.

The essential points of the method referred to are agitation for twenty minutes in an alkaline soap solution at 102°–110° F., squeezing through rollers, agitation for twenty minutes in 2–2½ per cent. formaldehyde solution at 102° F., squeezing through rollers, drying in a current of air at 160° F., and exposure for some days to dry air. The most valuable portion of the whole English method of handling the anthrax problem in wool and hair is the insistence on disinfection at the port of entry, if not sooner, in a government institution with adequate bacteriological facilities, of all materials imported from suspected countries, the small cost of disinfection being a charge against the product. This absolutely protects the worker and the consumer and seems to be an ideal plan.

Tests with cyllin had been planned as part of this investigation, but after the receipt of Dr. Legge's letter it was decided to publish the report before the cyllin had been received. A communication just received from the English company handling cyllin contains the following additional recommendations for its use.

1. Blood clots in the hair must be gotten rid of. This is done by passing the mixture through rollers and crushing the blood clots, etc.

2. Unless the most scrupulous care is taken in immersing the horsehair in the solution some portions of the hair are liable to remain unacted upon by the disinfectant owing to air locks, . . . place the hair in a vacuum cupboard, evacuate the air, and allow the solution to be sucked up from a reservoir beneath.

These precautions call for elaborate and expensive apparatus beyond the means of the small hairdressers in this country and emphasize the value of the English plan for central disinfecting stations.

Summary

The results of the entire investigation may be summed up as follows:

1. No anthrax was found in domestic hair, but circumstantial evidence is offered from vital statistics reports as to the possibility of anthrax-infected domestic hair occasionally reaching the hairdressers.

2. Virulent anthrax bacilli were isolated from a sample of dressed Chinese hair imported under consular certificate, and reports are cited of the same findings occurring frequently in other cities.

3. The absolute inefficiency of the Department of Agriculture rule for disinfection of hair, even when opened out freely, by exposure to 200° F. for fifteen minutes was demonstrated experimentally.

4. The effectiveness from the point of view of anthrax destruction of exposure of loose hair to 200° F. for 24 hours was demonstrated.

5. The effectiveness of washing hair in hot alkaline soap solution as recommended by the Bureau of Animal Industry inspectors in Philadelphia at present was shown but the fact noted that this washing does not protect the washer nor does it keep the stock rooms from becoming infected.

6. The absence of much dust in dressing washed hair was observed but considerable dust, liable to contain *B. coli* and other organisms from soil or animal sources, was seen in the dressing of unwashed hair.

7. General lack of cleanliness was observed, as well as the presence of evident fire risk in most of the establishments visited.

Recommendations

As a result of the above findings and of the absence of any protective rulings in this state the following recommendations or suggestions are offered:

1. Absolute insistence on the sterilization by steam under pressure for at least sixty minutes at 15 pounds pressure (above atmospheric pressure) of all imported dressed hair in bundles, the bundles to be stacked loosely and not closely piled in the autoclave and all air to be exhausted before obtaining pressure.

2. Absolute insistence on the sterilization of all imported undressed hair from countries where anthrax is prevalent by: (a) steam under 15 pounds pressure for at least two hours for baled hair with the same precautions as above; or (b) dry heat at 200° F. (controlled by the thermometer) for at least twenty-four hours for hair opened out loosely from the bale by forking and not by hand pulling, the opener to wear some type of mask or gauze protection over mouth and nostrils, and not to work in such unsterilized hair unless free from any form of open skin lesions; and the washer to wear overalls and cap, which should be sterilized by boiling or by steam after the washing of quarantined hair; or (c) disinfection by washing in hot alkaline soap solution followed by $2\frac{1}{2}$ per cent. formaldehyde by the method used in England or by drying twenty-four hours at 200° F.; or (d) boiling dressed hair for at least three hours, as permitted in New York City (9).

3. Prohibition of the dressing of any unwashed hair whether foreign or domestic. The hair should be washed, as at present recommended by the Bureau of Animal Industry inspectors, in hot alkaline soap solution and dried at 200° F., unless so washed before receipt and accompanied by a certificate to that effect.

4. Separate storage for all unwashed hair apart from washed hair.

5. Disinfection of rooms in which unwashed imported hair from anthrax-infected countries has been stored as soon as the hair is removed for disinfection.

6. Lime washing or painting of all work or store rooms at least once a year.

7. Wet sweeping of all work or store rooms at least once a week, preferably daily.

8. Removal of all loose hair litter from benches and store rooms at the close of each day.

9. Informing workers, especially hair washers, of the danger of anthrax infection, the importance of washing well after handling unwashed hair and the importance of prompt attention to all skin wounds, however slight, or any localized skin lesion.

Preferable to those of the above suggestions which apply to foreign hair would be the adoption by the state, by several states or, better yet, by the federal authorities, of the English plan of establishing governmental disinfecting stations at one or more ports of entry, all imported hair and all wool from anthrax areas to be disinfected at such stations by standard methods before entering domestic commerce, the cost of disinfection to be charged against the infected or suspected materials. This latter plan would absolutely protect not only the hairdressers, but any hair handlers, from dray men and laborers to hair curlers, haircloth weavers, tailors and milliners, brush makers and brush users.

BIBLIOGRAPHY

1. Osborn, S. H.: Anthrax Problem in Massachusetts. Am. Jour. Pub. Health, 1920, **10**, 657.
2. Mortality Statistics, Bur. Census, 1918, p. 35.
3. Andrews, J. B.: Anthrax as an Occupational Disease. U. S. Bur. Labor Statis., Bull. No. 267, 1920, pp. 58–98.
4. King, R.: Anthrax from Removing Hide from Mule. Jour. Am. Med. Assn., 1920, **75**, 376.
5. Joint Order No. 2, U. S. Dept. Treasury and Dept. Agriculture, Jan., 1918.
6. Medical News: Anthrax in Shaving Brushes. Jour. Am. Med. Assn., **75**, 945.
7. Hagan, W. A.: The Diagnosis of Anthrax from Putrefying Animal Tissues. Jour. Bacteriol., 1920, **5**, 343.
8. Report of the Departmental Committee Appointed to Inquire as to Precautions for Preventing Danger of Anthrax in the Manipulation of Wool, Goat Hair, and Camel Hair. Cd. 9172, Vol. 2., H. M. Stationery Office, London, 1918, p. 30.
9. New Regulations to Prevent Anthrax. Weekly Bull., Dept. Health, N. Y. City, 1920, N. S., **9**, 201.

A STUDY OF PULMONARY SILICOSIS*

E. L. MIDDLETON, M.D. (Ed.), D.P.H.
Medical Officer to the Welsh National Memorial (Tuberculosis) Association

THE present paper represents an attempt to examine, from a clinical standpoint, a series of cases of pulmonary disease in which the patients were exposed to the inhalation of dust of high silica content in their occupations. All the cases were referred to the writer by private practitioners on evidence or suspicion of the presence of tuberculosis, and the chief interest of this study, therefore, is the mode of presentation of such cases as it occurs in general medical practice, and the possibility of deducing therefrom some method in the diagnosis and management of this type of disease. Better facilities for the earlier diagnosis of these difficult cases may become available in the future; a systematic scheme of industrial hygiene may be applied to the small bodies of workers who follow the more primitive of these industries in the secluded quarries and mines up and down the country; preventive measures may, by and by, place them on an equality with their fellows, who, being aggregated in large industries, claim more attention and receive help to pursue their work in safety. Such a desirable scheme of progress will probably sooner or later be realised. One group of the industries considered here — namely, the refractories industries — is already the subject of special regulations under the Factory and Workshop Act and of a scheme under the Workmen's Compensation (Silicosis) Act, 1918 — an act which is likely ere long to receive more extensive application.

The industries dealt with in the present contribution include: (1) manufacture of silica bricks, and silica flour milling, 18 cases; (2) scythe stone making, 6 cases; (3) lead mining, 16 cases; (4) quarrying, 6 cases; (5) stone-dressing, 11 cases.

* Received for publication Aug. 23, 1920.

Pathogenesis

The exciting cause of silicosis among the workers in the industries mentioned is finely divided dust containing a high percentage of free silica which is inhaled during various mining operations or trade processes. The conditions which lead to the development of the disease appear to depend on several factors among which special importance may be attached to (a) the amount of free or pure silica in the dust and the number and size of particles in the inspired air; (b) the condition of the atmosphere as regards gaseous impurities and moisture; (c) the physical condition of the worker; (d) accessory influences not directly connected with the employment.

Air Pollution by Dust. — Many ingenious devices have been invented for determining the amount of dust in a given volume of air and as a review of many of the methods was given in detail by Dr. Henry F. Smyth (1) in a recent number of this Journal it is not necessary to describe them now. Suffice it to say that the reviewer concludes that "no single method of our sampling for dust content as yet devised, is ideal." He suggests that "for complete studies and for fixing of permissible limits of dustiness, tests must permit of estimating weights and counts and determinations of the physical and chemical nature and size of dust particles. These tests are, at present, best and most easily made on samples collected with the Palmer apparatus, though the sugar filter samples treated according to Muir and Johnson's technic give as much information." A

criticism of the Palmer apparatus compared with an electrostatic method is given by Dr. J. Penteado Bill in another number of the Journal (2). The South African Phthisis Prevention Committee have investigated and described an instrument called the Kotzé konimeter, and they recommend it as "estimating speedily, and with a reasonable degree of accuracy, the quantity of dust in mine air . . . whilst the figures obtained are easily translated into general terms of effective and non-effective dust laying" (3).

The important points about silica-dust estimation are (1) that the particles can be counted and the number stated per cubic centimeter of air, and (2) that particles over 12 microns in diameter can be excluded as non-injurious. Gravimetric methods carry the serious objection of underestimating the dangerous properties of a dusty atmosphere; thus, a single particle of 100 microns diameter weighs the same as 125,000 particles of 2 microns diameter; the former on account of its size is non-injurious, while the latter are extremely injurious.

The amount of dust in the atmosphere of a workplace varies within wide limits according to the operations carried on and to such conditions as air currents and moisture. The South African committee, basing their standards on results attainable in practice, found that "to reduce the dust, as determined by the Kotzé konimeter, breathed by persons below 300 particles per cubic centimeter is not difficult in any operation. Anything above this is to be classed as unsatisfactory. Between 200 and 300 may be considered as fair, between 100 and 200 as good, and below 100 as very good" (4).* These conditions apply to the various operations in the gold-mining industry which include machine and hand-drilling, blasting and crushing a conglomerate of quartz pebbles in a siliceous matrix embedded in quartzite. The conditions of gold mining are very different from such processes as stone-dressing; but the committee also carried out some counts in the atmospheres of such industries for purposes of comparison, and found the states of dustiness similar. Thus, a monument mason working on moderately hard granite was found to be breathing air with 350 to 800 particles per cubic centimeter, of which 90 per cent. were fine. In two cases of stone-dressing by machines, the air had 1,000 particles in one, and in the other the dust was too thick to count, probably 2,000 or over. In the case of a man cutting sandstone, there were 200 particles, of which 85 per cent. were under 5 microns — yet the stone appeared to be damp.

The Essential Fineness of Dangerous Silica Dust. — The size of the silica particles is a consideration of the utmost importance in the causation and prevention of silicosis. On examining a section of silicotic lung, it is observed that the great majority of the particles included in the lung tissue are less than 2 microns in diameter and more than half the total are 1 micron or less in size, while few are above 3 microns. It follows from this, that the naked-eye appearance of the atmosphere of a workplace is no criterion of its safety, for the most dangerous particles are invisible under good conditions, and even much coarser contamination of air would be unrecognisable in the deficient light of mines, kilns, and sheds. Another important result follows from the fineness of the dangerous particles — namely, the difficulty of finding a respirator capable of arresting a safe percentage of the dust. Tests by the South African committee on respirators showed that they could stop about 50 per cent. of the particles entering the inlet, but all the particles which got through were about 1 micron in diameter and, therefore, dangerous. To increase the efficiency of the

* It must be mentioned, however, that there were several dissentients from the fixing of this standard as being too low to be readily attainable in practice.

respirator as a dust-trap is to increase the embarrassment to the breathing of the wearer. The dust which causes the lung changes in silicosis is, then, the very fine silica particles of less than 12 microns and averaging little more than 1 micron in size. But it is probable that the larger particles also play a part in the pathological processes. In densely polluted atmospheres, the nostrils of the workers become coated on the inside with fine irritating dust which produces catarrh of the mucous membrane and, in some cases, loss of the protective vibrissae of the anterior nares. The whole upper respiratory tract suffers in some degree and a chronic hyperemia or congestion of the nasal and pharyngeal mucous membrane is commonly found. The larger particles, which are liable to be caught in the air passages are the chief cause of these changes, while the very fine dust passes to the bronchioles and alveoli in the free midcurrent of the inspired air.

Specific Qualities of Silica as a Disease Producer. — Recent researches and the observations of numerous investigators, indicate that the purity of the silica dust must be recognised as a factor of prime importance in the causation of silicosis. Unfortunately mortality statistics of silicosis are not available, but much attention has been given to the increase in the mortality from pulmonary tuberculosis in workers in materials containing free silica. As the evidence favors regarding phthisis as a frequent cause of death in persons suffering from silicosis. the inference is permissible that the statistics referred to can be used as evidence of the existence of silicosis.

Silica dust in its purest form is inhaled by the workers in the primitive industry of flint-knapping, and an investigation of the industry by Professor Collis (5) led him to regard the percentage of silica in any dust as directly associated with its power of inducing or predisposing to phthisis.

Experiments on guinea-pigs were carried out by Professor Beattie (6) in examining the effects of various dusts by inhalation. In the experiments, the animals were so confined as to inhale a large amount of dust over certain periods of time and afterwards the results were studied in the lungs postmortem. Fibrosis. with more or less obliteration of lung tissue, was found as the result of inhalation of many kinds of dust, such as tin-mine and lead-mine dust, pottery dust, slate-quarry dust, granite, carborundum, emery, cement and limestone dust. Thus fibrosis can be induced, in animal experiments at least, by the inhalation of dusts which in the industries are not associated with a high phthisis mortality — e. g., cement and limestone — as well as by the inhalation of dusts which are always associated with a high phthisis mortality — e. g., flint (pottery) and tin-mine dust.

The explanation of this apparent discrepancy may lie in the nature of the fibrosis and the reaction of the tissues to chemical properties possessed more preeminently by silica than by silicates or other minerals — a reaction which produces such an alteration in the tissues that the tubercle bacillus finds a suitable nidus for its growth. Further reference to this point will be made later, when the morbid anatomy is discussed.

The admixture of certain relatively inert dusts with silica dust is claimed to have a beneficial effect in stimulating the natural reaction of the bronchial secretions and cilia in ridding the lower air passages of the dangerous dust before it has become fixed in the tissues. A series of animal experiments was carried out at the suggestion of Dr. J. S. Haldane by Mr. A. Mavrogordato (7) with a view to "attempt some classification of dusts into those which predispose to phthisis or other serious lung troubles and those which do not." The results of this series of experiments led this

observer to make the following important deductions. The initial reaction is greater to "inert" dusts than to "dangerous" dusts and their elimination is more rapid and more complete. The admixture of inert dusts such as coal and shale with dangerous dusts stimulates the initial reaction, and brings about the elimination of more of the dangerous dust than would be eliminated in their absence. With the dangerous dusts the rate of elimination being slow, the dosage must be very small to avoid accumulation. The more free crystalline silica is from certain inert dusts, the less is the elimination and, therefore, the greater the accumulation in the lung tissues and the greater the fibrosis resulting.

The physical condition of the silica, apart from the size of the particles, may have an effect. Amorphous precipitated silica used in the series of experiments mentioned showed practically dust-free lung tissues, the inference being that this form of silica is soluble in body fluids, and its rapid removal obviates any change in the tissues themselves. Further experiments with this form of silica seem to be called for. It is possible that dense clouds, or longer exposures or both, would lead to accumulation, and then a positive or negative observation might be obtained of biochemical reaction in the tissues, comparable with what we assume occurs with the crystalline form and predisposes to attack by the tubercle bacillus.

Pathology

Gross Characters. — The appearance of the silicotic lung presents a departure from the normal in proportion to the severity of the disease present, the abnormal developments being along certain well-defined lines. The lung, though altered in consistency, may be normal in size and, in uncomplicated silicosis, may retain its form instead of collapsing, while in lungs in which tuberculosis has supervened and reached a chronic stage, contraction and loss of bulk may be marked, varying in degree and in situation.

Pleural adhesions are rarely absent. They may be massive and associated with greatly thickened pleura, or less dense and presenting on the surface of the lung a finely nodular appearance. Over most of the subpleural nodules there is a central zone of thickened pleura which is whitish, while the outer zone is a grayish-black.

The weight of the lung is always increased when silicosis is present. "When complications are absent it may be stated that the increase in weight corresponds to the stage of the disease" (8). Increase in weight may amount to twice the normal weight in advanced silicosis, when complications such as edema and pneumonia are included.

On section the lung may present some resistance, depending on the density of the older fibrotic areas; the cut surface presents a characteristic appearance of scattered nodules of a grayish-black color, more or less rounded in form and from 2 to 5 mm. in diameter, distributed throughout the lung. The nodules appear to vary in density and some show a central bronchiole or blood vessel, though others are uniformly dense. The intervening lung tissue shows a varying degree of emphysema. Dr. Watkins-Pitchford (8) describes three stages of change in the lungs of Rand miners with uncomplicated silicosis — the discrete, reticulated, and diffuse pigmentation — while the appearance of nodules called "fibrotic figures" indicates the presence of the tubercle bacillus in the silicotic lung.

Cavities of various sizes and forms may be present. Some of these bear the characters of chronic tuberculous cavities with vessels traversing them and with smooth walls. Such a cavity, $1\frac{3}{4}$ inch by 1 inch,

occurred in a ganister miner's lung described by Dr. F. W. Andrewes (9). A cavity of 2 inches in long diameter was described by Dr. Greenhow (10) in the lung of a millstone maker and stonemason who suffered from silicosis and who died of hemoptysis. The walls of the cavity in this latter case were "shreddy and black" and it contained a small quantity of dark bloody fluid. Fibrous nodules similar to those described in silica-stone workers were found in the diseased lung of a pearl-shell cutter examined by Dr. Greenhow (11), and it is interesting to note that the symptoms and course of the disease resembled those of the other pneumonoconioses (12). Professor Collis has pointed out to the writer that it was the sandstone wheels on which the pearl shell was worked which caused the disease in such cases, and that with wheels manufactured of abrasives which contain little or no free silica the trade has lost its excessive phthisis mortality.

Incineration Results. — If the lung be dried and incinerated the ash is found to contain silica. This fact was established by Dr. Greenhow (12) in 1865 in a case of grinder's asthma. In the cases reported on by Dr. F. W. Andrewes (13) in which the analyses were made by Dr. Scholberg, the dried lung of one case yielded a little over 3 per cent. of ash, with 24 per cent. and 36 per cent. of silica respectively in two different portions of the same lung, the higher percentage occurring in the less affected part — i. e., in parts not containing an abundance of new fibrous tissue. The other case yielded 6.6 per cent. of silica in dried lung. In a series of incineration analyses carried out by Dr. John McCrae and published by the South African Institute for Medical Research (14), the ash and silica content of the lungs of six Rand miners, who had suffered from silicosis, are compared with those of a Zulu, aged 30, who had never worked underground and whose lungs presented entirely normal appearances on postmortem examination. It was observed "that (1) the total weight of silica in the diseased lungs was much higher (from 2.8 to 9.6 gm.) than in the normal lung (0.55 gm.), and (2) the proportion of silica in the ash of the diseased lungs was much greater (from 29 to 48 per cent.) than in the normal lung (14.7 per cent.)."

Microscopic Structure. — Microscopic examination of a portion of affected lung shows particles of pigment, distributed according to the stage which the transformation of lung tissue has reached. With ordinary illumination, the particles are not readily seen, but with polarized light, they show up as minute brightly refracting particles; compared with the appearance by ordinary illumination the sites of clusters of particles can be traced as areas of yellowish pigment, which, on careful focussing, show a highly refractive appearance.

At the least affected parts, the pigment is found in minute granules within cells which resemble epithelial cells; the granules may be few and discrete or so numerous as to appear as a dense mass enlarging the cell and obscuring its structure. The cells containing the granules may be lying free in alveolar spaces, or more commonly they are in clumps between the walls of alveoli which are becoming disorganised by the processes of cell proliferation, invasion and condensation taking place at the periphery of a nodule. Granules may also be seen, however, lying free in the supporting connective tissue of the alveoli or in any of the interstices between fibers of organised new tissue. Following the distribution of the granules towards a nodule, it is observed that they are most abundant in proximity to the blood vessels which accompany the bronchioles. In such situations they occur in masses of a dark and dense appearance, which are grouped together at certain points in relation to the blood vessels; this grouping is so constant as to suggest a

structural cause, probably the site of the perivascular lymphatics, which are occluded by these masses of granule-laden cells.

On the edge of a nodule, where active proliferative changes are occurring with leucocytic infiltration, connective tissue proliferation, and fibrous tissue formation, granules are found scattered about, for the most part within cells, but sometimes free and in little streaks between young fibrous strands, as if granule-bearing cells had there been strangled and absorbed, leaving the mineral deposited to accentuate the irritation and bring about the formation of fully formed fibrous tissue which forms the basis of the nodule itself.

The nodule composed of dense fibrous tissue usually appears round in section, with roughly concentric arrangement of the fibers. This may be varied by the appearance of several centers around which the fibrous tissue is arranged, giving the effect of several smaller nodules within a single capsule which presents the advancing margin to the lung tissue at the periphery.

Each nodule presents a more or less similar structure. The densest fibrous tissue is near the center; surrounding this are strata of less dense and younger fibrous tissue, outside of which is the area of cellular activity described before. The center of the nodule commonly shows some change which is interesting. Here, the tissue is looser in texture, less definite in structure, and has the appearance of breaking down in a way which suggests what occurs in tumors and in fibroid nodules found in non-silicotic fibroid phthisis (15) (16).

Granules abound at this central zone, and it appears possible that this tissue with a deficient blood supply, the constant presence of an unimpressionable irritant, and an increasing pressure from new fibrous tissue around it, is undergoing necrosis, and may form a cavity, or retain this necrosed material *in situ*. It is in such situations that the Bacillus Tuberculosis is commonly found in advanced silicotic lungs, when typical tuberculous processes may not be evident in the lung. The presence of tuberculous infection is most usually accompanied by an unequal development of the silicosis in a lung or lobe, as the presence of tuberculosis tends to hasten the development of silicosis, especially in the earlier stages (17).

The bronchi show more or less complete catarrh of the ciliated epithelium. The mucous membrane generally shows chronic inflammatory changes, with dilatation of blood vessels, cellular infiltration and increase of interstitial tissue. The perivascular and peribronchial connective tissue is increased. The alveolar tissue shows congestion, dilatation of capillaries, increase of supporting connective tissue and catarrh of the epithelium. In the vicinity of the nodules, the lumina of the alveoli are, in parts, filled with cells derived from desquamated epithelium and from the invasion of leucocytes, giving the appearance of localised bronchopneumonia, while their walls are undergoing condensation and organisation by the infiltration of fibrous tissue from the nodules. At other parts the alveolar tissue shows emphysema.

Advance of the disease, as shown in parts more affected, takes the line of increase of connective tissue around the vessels and bronchi, with alteration of the loose tissue at first formed to denser fibrous tissue and gradual increase of the nodules at the expense of the surrounding lung tissue. The larger nodules are formed by the meeting and merging of smaller nodules through the obliteration of intervening areas of functioning lung.

The distribution of the mineral particles suggests that the perivascular lymphatics are earlier or more severely affected than the peribronchial. This distribution of foreign particles is seen also in sections of

non-silicotic lung, where carbon pigment is seen much more constantly in the perivascular than in the peribronchial lymphatics. This fact gives strength to the hypothesis that the blood vessels become obliterated before the corresponding bronchiole is rendered incapable of functioning, and that, indeed, the formation of fibrous nodules in the perivascular tissue may determine the fibrous obliteration of the bronchiole as a secondary stage of the process.

The obstruction of the blood vessels before the bronchioles may explain the absence of cyanosis in subjects of silicosis, who, in this series at least, present an unexpected absence of this symptom considering the degree of dyspnea which is usually the earliest and severest symptom (18). In contrast, however, cyanosis is typically present in cases of fibroid disease of the lung supervening on causes other than dust inhalation (19).

Symptoms

Variable Nature and Time of Onset. — A considerable period of time may elapse before symptoms show themselves even when an interval has been spent away from the dusty industry. Some authorities appear to regard a period of about ten years' exposure to the dust to be necessary before its effect can become manifest, but in the present series there is evidence that, in a much shorter time, sufficient dust can be inhaled to produce signs and symptoms which appear after a varying lapse of time. One of the writer's patients was exposed to silica dust under very bad conditions at the age of 15 and for a period of two years thereafter. Subsequently, he worked at non-dusty occupations and at 23 was examined because of a cough, but apparently nothing definite was found. At 28 he had influenza and slight pleurisy, and six weeks later he was examined by the writer and physical signs of early silicosis were found and noted. The symptoms all cleared up and, although he felt quite well and was unaware of any symptoms for two years, at the end of that period the physical signs were even more definite.

In another case in this series, the patient was exposed at the age of 20, for six weeks only, under very bad conditions. A history of cough and dyspnea dated from the time of exposure until he was seen by the writer three years later. Physical signs were found which could not be accounted for until subsequently when the history of exposure was obtained. Another patient, aged 42, showed very definite symptoms and physical signs two years after the commencement of a period of nine months' work in the silica-rock industries.

There are two points to remember, then, regarding the onset of symptoms: first, the period of exposure may have extended over only a few months, or even weeks in exceptional cases; and, second, the onset of symptoms may date from the time of exposure or from a variable time after the exposure has ceased.

In forty-nine cases of this series the period of exposure to silica dust in the industry under which each is classed, varied from 6 weeks in the case of the shortest, to 37 years in the longest, the average being 14.26 years. The shortest periods of exposure were found in the silica-stone workers' group, the longest in this group being 18 years, the average 3.75 years. The highest average duration of exposure was found among the stonemasons where the average was 22.3 years. The period of time which elapsed from the commencement of exposure until the admitted onset of symptoms, varied from 2 years in the case of a silica-rock worker to 48 years in the case of a lead miner, the average being 18.95 years.

No undue importance is attached to the influence of the particular industries here

considered, as many of the workers were employed at various times in other industries though, as far as possible, fallacies so arising have been excluded.

The Insidious Early Symptoms: Dyspnea. — The earliest symptom observed in an important proportion of the cases was dyspnea, although the commencement and increase of this symptom may be so insidious that it is not observed until some intercurrent catarrh produces an exacerbation. In the present series of fifty-seven cases, twenty-four gave dyspnea as the first symptom noticed. It was more frequently complained of by the older patients, as might be expected, the average age at the onset where this symptom predominated being 42.45 years, the youngest being 27 and the oldest 63.

It is doubtful, however, if the real duration and intensity of this symptom were correctly judged by the patients, as some had left the dusty industry for other occupations on account of their condition of health, before the onset of definite dyspnea would have been admitted. Thus, of the twenty-four cases in which dyspnea was the initial symptom, ten had left the industries for various reasons before the admitted onset, the average time which elapsed between their leaving the industry and the onset of the symptom being 10.6 years. In the cases which gave dyspnea as the first symptom noted, the earliest appearance was 2 years after exposure and the longest 30 years, the average being 20 years. Of these twenty-four cases, fifteen had worked in lead mines for variable periods and probably also in coal mines at intervals.

In cases in which dyspnea is the first symptom, it usually continues to be the worst throughout the course of the disease. It is present in some degree in every established case and, apart from complications, it can be relied upon as a guide to the degree of fibrosis present. It is commonly discovered by the patient for the first time when an intercurrent catarrh is present and the morning cough is troublesome. Inspiration is never complete and he has the feeling of "not getting to the bottom of his breath." As the chest wall becomes more fixed and the diaphragm is relied upon more and more for inspiration, anything which interferes with the action of the latter increases the dyspnea, such as exertion in a cramped position. It is remarkable the degree which objective dyspnea may reach, before the patient will own to discomfort on this account, chiefly because he avoids, more or less unwittingly, anything which will aggravate it.

Cough. — Cough occurs next in frequency as the initial symptom, and was given by thirteen patients in this series as the first observed. It was noticed first in five out of eleven stonemasons, in which group dyspnea was never given as the first symptom. In typical cases of older men, the cough is short and paroxysmal and occurs most at night and in the morning. In more advanced cases it is induced by any exertion which is associated with dyspnea. The common pleuritic attacks are accompanied by the short, irritative cough generally found with any form of pleurisy. The paroxysmal cough is generally followed by expectoration, which is commonly scanty, but may be absent or, on the other hand, copious and frothy or mucopurulent.

"Influenza" and "colds" were given as the onset in eight cases. This accords with the general experience in insidious disease; namely, that what is really an exacerbation due to an intercurrent illness, a secondary infection, or the supervention of a complication, is taken as the commencement of the illness (20), or, at least, affords a convenient place in the anamnesis to begin the record of symptoms. In some of the cases, such an onset proved to be the beginning of a more acute stage of the disease.

Other initial symptoms given were: pain in the chest, 5; weakness, 4; indigestion, rheumatism and pneumonia, 1 each.

Hemoptysis. — Hemoptysis was never the first symptom but it occurred in sixteen of the fifty-seven cases during the course of the illness, and varied in amount from definite coloration of the sputum to quantities of a pint or more. In two cases the hemoptysis was so severe as to prove fatal; in two others it was severe (over ½ pint); in seven it was slight (under 4 ounces); and in the others, streaks and coloration of the sputum. In both of the fatal cases, tubercle bacilli were found in the sputum. In one of the severe non-fatal cases, the hemorrhage occurred in a man, aged 30, two years after an attack of pleurisy. This patient, a stonemason, died at the age of 45 from spontaneous pneumothorax. In the absence of a sputum report, the history indicates that this case was tuberculous. In five of the seven cases of slight hemoptysis, tubercle bacilli were found, and also in one of the four cases with colored or streaked sputum. The other severe non-fatal case was a florid alcoholic of 53 with very scanty sputum and extensive pulmonary fibrosis. Generally speaking, then, hemoptysis may be associated with the presence of a tuberculous process.

Other Symptoms. — Pleuritic pains are common during the course of the illness, and may appear early; fluid effusions have been met with in tuberculous forms; and spontaneous pneumothorax occurred in two cases. Pains of joints and muscles were complained of by some patients, more especially of the lead-miner series.

Of other symptoms, night sweats occurred in 27; weakness in 47; and wasting in 45. With regard to the last three symptoms, they were found in most of the advanced cases, but night sweats did not occur at all in a few. The causation of these symptoms is probably related to the economic position in which the incapacitated worker finds himself after months or years of invalidism.

Physical Signs

In the last section the onset of symptoms, as stated by the patient, was shown to be unreliable; it may be delayed, and is frequently due to an exacerbation from the occurrence of a secondary catarrh or the supervention of tuberculosis. The first indications of the departure from a physiologically sound lung condition are demonstrated by physical signs. This seems to be logical when it is remembered that symptoms depend on the failure of a system, while physical signs may be capable of detecting a fault in a portion of the organ before the wide physiological margin has been overstepped, and symptoms originated.

Silicosis is a disease only according to the degree in which it departs from the accepted normal of adult life, and there is danger, therefore, of classing as diseased, what is relatively little abnormal for the age and constitution of a particular individual. Only by collecting information regarding the slightly affected cases can knowledge be arrived at as to what degree of divergence from normal is to be regarded as requiring precautionary measures, such as removal from an industry, and what may safely be allowed to pass. The danger and difficulty, of course, lie in the time which it takes for the inhaled dust to produce the pathological changes in the lung to which the physical signs and symptoms are due. The presumption is, that if symptoms are already observed, or even physical signs which can be recognised as being due to early silicosis, the person giving such evidence should be excluded from the industries, because the process does not cease when inhalation of dust ceases, but the distortion of the lung goes on in proportion to the amount of dust inhaled and the factors

governing the pathological processes which ensue.

Early Diagnosis. — A diagnosis should be made as soon as possible. Routine examinations in dusty industries are, therefore, greatly to be desired. The physical signs, however slight, at each examination should be charted, and variations in later findings carefully noted and their value assessed.

On physical examination the general aspect of the patient conveys very little unless the disease is advanced. There is, however, none of the apparent robustness or flush of health in this series that was noted by Oliver in the gold miners of South Africa (21). The conformation of the chest may present change. This usually takes the form of flattening anteriorly, with more or less round-shouldered deformity. The barrel-shaped chest of the emphysematous type is not seen in most cases. The infraclavicular fossae and the intercostal spaces tend to be hollowed, and the extraordinary muscles of respiration are active more or less, depending on the development of fibrosis. The skin is generally pale and subcutaneous venules about the front of the chest are frequently noted. Diffuse pulsation may be seen over the precordia. The musculature has usually lost much in bulk and consistence, and the general nutrition is practically always below normal.

The expansion of the chest is always diminished, usually equally on the two sides, but not infrequently more on one side than the other. Resonance is always diminished, especially about the apices and low down in the axillary areas, but the note may be variable, and over the anterior of the chest hyperresonance may be noted. Areas of dullness may be found irregularly distributed and especially associated with thickened pleura about the bases. The breath sounds are frequently diminished in intensity in various areas, especially at the bases posteriorly; they are typically of a high-pitched and "whiffing" quality in more advanced cases, and over some areas are bronchovesicular. Deep or distant bronchial breath sounds may be heard frequently in the interscapular regions, and, in tuberculous cases, bronchial or amphoric breath sounds can be heard.

Adventitious sounds may be absent even when extensive alteration of the respiratory murmur is present, but, apart from the modification of the breath sound which is the most typical and the earliest of all the signs, the earliest added sounds are fine sibilant rhonchi, which may have their greatest intensity in any area.

Crepitations at the lung margins are commonly heard and are not of much significance, but when indicating moisture, they are often associated with the presence of tuberculosis, but not necessarily so, as secondary catarrhal conditions and post-pneumonia consolidations frequently present such signs. In early cases, special importance should be attached to slight alterations in the quality of the breath sounds associated with diminution of intensity, and the presence of sparse adventitious sounds, especially rhonchi, provided that such signs are persistent in character, though they may vary to some extent in apparent position.

The Early Physical Signs. — Abnormalities of the upper air passages of a congenital or acquired kind should be excluded, especially such conditions as nasal obstruction and chronic catarrh; otherwise, the physical signs may be misleading. The commonest site for the early signs to be found is, in the writer's experience, in the right mammary region. Above the fourth rib the breath sounds may be of a harsh character and rather puerile in quality; below this, and sometimes sharply delimited, the characteristic fine vesicular murmur is found of a soft "whiffing" quality and associated with diminished vocal resonance. Later this extends into the axillary region, and

still later can be found at the corresponding site on the left side. The early fine sibilant rhonchi which appear can be heard equally well from the mammary area, or posteriorly about the angle of the scapula. The respiratory murmur over the other areas may be normal or, more usually, slightly harsh and with slightly prolonged expiration.

With the occurrence of tuberculosis in a silicotic lung, the physical signs tend more and more to resemble ordinary chronic phthisis as the tuberculous process extends. For a time the character may be more fibroid in type, but at length localised foci of breaking down occur and the character of the physical signs and the course of the symptoms change accordingly.

Radiography. — Radiography provides a valuable addition to the ordinary means of diagnosing silicosis, and, in addition, can give useful help in detecting the presence of tuberculous foci and other complications.

In early uncomplicated cases of silicosis the hilus shadows are seen to be increased, and the branching shadows which radiate from them appear thicker than normal. The linear shadow of the interlobar fissure, referred to in one of the cases cited later, is met with. Finer branching shadows may be seen in the peripheral parts. With more advanced silicosis the branching shadows increase in number and density with a tendency to run together, so forming a general mottling. In later stages, rounded dense nodules are scattered more or less uniformly throughout, giving the so-called "snow-storm" appearance referred to by South African observers (22).

The presence of tuberculosis is denoted by greater density and increase of hilus shadows; sometimes evidence of calcification of bronchial glands may be seen with increase of the shadows thrown by the larger bronchial trunks. Localised foci in the lungs show as more or less dense shadows with irregular outline in spreading disease or sharply defined in localised consolidations. As with clinical signs, increasing tuberculous disease tends to obscure the characteristic radiographic appearances of silicosis.

Typical Instances

The description of *an early case* will serve to illustrate the physical signs of this stage.

Case 1. — H. P., a man aged 39, giving a satisfactory personal history, was employed five years previous to examination at a silica-brick works and was exposed to dust more or less for four years, when he was advised to leave off this work. Just before the end of his third year he observed dyspnea, and six months later a cough at night. He was examined by the writer eight months after he gave up the work.

The general condition was fairly good and the musculature satisfactory. Nasal vibrissae were very good; the fauces slightly red. The radial artery was thick for the age of the patient; the first cardiac sound was impure; the apex beat one-half inch internal to the nipple line in the fifth space.

The chest appeared symmetrical, but expansion was diminished — expiration 31 inches, inspiration 32 inches. Resonance to percussion was diminished on both sides posteriorly in the interscapular regions, especially on the left. Over the front of the right side of the chest, the respiratory murmur was weak generally and, on the right side posteriorly, there was diminished air entry from the spine of the scapula to the base margin. On the left side, in front, over the third and fourth spaces, breath sounds were harsh and expiration was prolonged, and towards the axilla base the sounds had a finer harsh quality. Posteriorly in the infrascapular region, the breath sounds were very harsh and expiration was prolonged in greater degree; just above this area, the resonance was definitely diminished.

No adventitious sounds were heard then, but the medical officer had noted "bronchitic" signs over both lungs nine months before. The radiogram showed an increase of the hilus shadows of both sides, with a linear extension outwards and downwards on the right, corresponding to the interlobar fissure and associated with some mottling towards the mesial end and in the region of the scapular angle; the hilus shadow was also increased upwards. A somewhat conspicuous shadow on the left side just above the heart shadow indicated what was probably an early tuberculous consolidation.

An intermediate case will now be described.

Case 2. — I. W., aged 43, a bricklayer, was formerly employed in house building, but for the ten years previous to examination had been employed at a steel works, building and repairing the brickwork of furnaces. Several kinds of bricks were used, including fire-clay, ganister, and silica bricks, and much dust was produced from chipping and handling the bricks in building, and in pulling down the furnaces for repair when hot.

Dyspnea was the worst symptom and had been noticed for four or five years; pain in the chest on coughing, for the same time. The cough was paroxysmal and chiefly at night; the sputum was scanty, streaks of blood had been noticed but never in quantity. No night sweats had occurred and no loss of weight. The patient was still at work at the time of examination. The general condition was poor, the muscles flabby and the patient looked thin and pale.

Resonance was diminished over both apices posteriorly. In front, over the upper part of both sides, from the clavicle to the fourth rib, the breath sounds were of a harsh character; below this area anteriorly, the breath sounds were diminished, and of a fine bronchial quality. Posteriorly, the upper area of both sides showed diminished air entry with breath sounds of a fine harsh character. At the left base near the angle of the scapula a few rhonchi were heard. No tubercle bacilli were found in the sputum. These physical signs are very typical.

An advanced case may be briefly described.

Case 3. — T. M., aged 53, was employed as a farm laborer until nineteen years previous to examination; for fourteen years thereafter, he was employed as engine driver at a stone quarry, and for four years subsequently he worked at silica-rock milling. For the last year he had been at a chemical works. At the time of examination dyspnea, which was the worst symptom, had been noticed for ten months, cough for three months. His sputum was white and frothy. Pain on both sides of the chest had been complained of in the past but was better. He had lost about 20 pounds in weight during the last year and weighed only 6 stone 5 pounds at the time of examination. He had night sweats a year previously but not since.

The general condition and the musculature of this patient were poor, and he looked senile and emaciated. The chest was thin and shrunken and expansion was scarcely perceptible; the neck muscles only appeared to move with inspiration. Respirations were short and hurried — 40 per minute at rest. The chest examination revealed evidence of diffuse bilateral pulmonary fibrosis. At the right base loud coarse friction sounds and some crepitations were heard. At the left base similar friction sounds and crepitations were heard in less degree. A loud systolic murmur was heard at the mitral area and propagated widely.

In none of these three cases were there characteristic symptoms or physical signs pointing to the onset of tuberculosis, nor were tubercle bacilli found in the sputum. In all, the distribution was bilateral, almost symmetrical and grouped about the central zones of the lungs, with a tendency to involve the bases rather than the apices.

An early case with the addition of active tuberculosis will now be described.

Case 4. — L. R., aged 21, was employed in a silica brickworks for three years, until about two years previous to examination when he went to work in a silica-rock quarry, at first on the rock and later on a rope-winding machine. He had had a dry cough for some years; rather severe dyspnea on exertion and indigestion for the last two years. A week before examination he had slight hemoptysis.

On examination he had cough, scanty sputum and pain at the left base; good appetite; no night sweats. The general condition and muscular development were good, but there was evidence of slight anemia. The chest examination showed, over the right upper lobe, a diminished resonance, diminished air entry, and crepitations after a cough. At the right apex posteriorly, the breath sounds were bronchovesicular. The pectoral muscles on the right side showed myotatic irritability. No tubercle bacilli were found in the sputum at this time even by the antiformin method, but they were found some weeks later. This case shows a characteristic history up to the onset of the tuberculous disease. The physical signs were almost entirely confined to the lung affected by tuberculosis.

An advanced case with tuberculosis is typified in the following:

Case 5. — W. J. W., aged 38, had been employed in a silica brickworks for twenty-one years. He had always been engaged in setting the bricks in the kilns, at first carrying-in, and then "setting" the bricks, an occupation associated with a dusty and often hot atmosphere in a confined place. He had been working regularly up to the time of examination, but felt that he must give it up. Five years

previous to examination he had pleurisy and had noticed dyspnea on walking up hills since; he had pneumonia eighteen months ago. At the time of examination he complained of cough and frothy sputum every morning with dyspnea, which improved as the day went on. He was worse on Monday mornings, and always worse in winter. Pains in the right side of the chest were fairly frequent. Tubercle bacilli were present in the sputum.

The general condition of the patient was poor; he was pale, and the muscles showed poor tone. The chest expansion was $34\frac{3}{4}$ inches to 36 inches. The radial artery was thickened. The nasal vibrissae were scanty and broken off short; the mucous membrane of the nostrils was hyperemic. Percussion showed dullness over the upper part of the right lung front and back, and diminished resonance over the left apex front and back, and over the right base. Air entry was diminished over the whole of the right base posteriorly and over the mammary and axillary regions; also over the whole left posteriorly. Over the upper half of the right lung, bronchial breath sounds and numerous crepitations were heard: over the upper half of the left side the breath sounds were harsh and a few crepitations and sibilant rhonchi were heard. Over the lower part of the left lung in front and in the axilla, the air entry was much diminished and the breath sounds were of a fine "whiffing" quality. The superficial cardiac dullness was diminished in extent; over the precordia the impulse was diminished. At the mitral area a soft diastolic *bruit* was heard; at the aortic, a short systolic and a long diastolic; at the tricuspid, a short systolic and a much prolonged diastolic; at the pulmonary, a short diastolic *bruit* and a reduplicated second sound.

The radiogram showed diffuse mottling over both sides with extensive dark areas corresponding with the upper half of the right lung, and a less extensive dark area occuping the site of the left subapex.

TABLE 1. — CASES OF TUBERCULOSIS FOLLOWING EMPLOYMENT IN DUSTY OCCUPATIONS

Occupation	No. of Cases	Employment in Industry in Years			Average Age at Onset in Years	Average Time in Industry before Onset in Years	Initial Symptom		Other Symptoms				T. B. in Sputum	Family History of Tuberculosis	Fatal Cases	Average Age at Death in Years	Average Term of Invalidism in Years	Average Duration of Symptoms
		Shortest	Longest	Average			Dyspnea	Cough	Hemoptysis	Night Sweats	Weakness	Wasting						
Silica-stone workers	18	6 wks.	18	3.75	37.0	13.2	9	3	7	5	14	13	5	5(1)*	8	39.5	1.83	3.8
Scythestone workers	6	2.5	33	21.0	38.66	17.2	2	1	3	2	5	4	2	3(2)	4	48.75	1.75	3.5
Quarrymen	6	..	..	..	41.83	..	2	..	2	3	4	5	6	2(2)	5	44.2	2.08	2.5
Lead miners	16	4	37	18.75	44.41	23.7	11	4	3	9	15	13	4	5(4)	12	48.58	1.58	3.75
Stonemasons	11	15	32	22.3	40.25	22.4	..	5	1	8	9	10	4	4	6	46.16	11.33 mos.	6.25
All occupations	57	..	..	14.259	40.41	18.95	24	13	16	27	47	45	21	19	35	45.5	19.45 mos.	4.0

* Numbers in parenthesis are additional cases with doubtful family histories.

This excellent workman was most amenable to any advice offered him, and was anxious to adopt any measures for the amelioration of his condition and to act as an example to his fellow workers. When seen first he was wearing a perforated zinc respirator fitting over the mouth and leaving the nostrils free. On advice he assumed the Keeling-Walker respirator. But the time for prophylaxis was past for him, and, for want of timely advice, he was an old man with a bad outlook at 38.

Prognosis

Silicosis. — With a fibrosis sufficiently extensive to affect more than a minimum amount of air tissue, a progressive course of symptoms is to be looked for. The amount of involvement necessary before definite disease can be considered permanent appears to vary with the individual. Every individual commences life with lungs free from silica, but as age advances an increas-

ing accumulation occurs from the inhalation of dusts to which he is fortuitously exposed, until, in adult life, silica forms an appreciable percentage of the lung ash. According to the exposure, on the one hand, and the efficiency of the natural defensive mechanism, on the other, the lungs become "aged" by the accumulation of dust and the resulting fibrosis. The term "silicosis," therefore, is relative, and implies that the sufferer has exceeded the limits of average balance between inhalation and elimination, with the result that a deleterious accumulation has accrued to his disadvantage.

The course of the disease, then, must vary with the factors involved. In some cases where the exposure has been very unfavorable — that is, when dense clouds of the finest particles have been inhaled, possibly in oppressive atmospheres or associated with arduous exertion so that mouth breathing has been the rule — symptoms may be found early and are then due to the catarrhal reaction. This reaction, in the case of pure silica dust, is never sufficient to ensure elimination of such degree as to prevent accumulation, for the reaction, from experimental evidence, appears to be less than in the case of "inert" dusts and, from clinical observation, shows a greater tendency to resist elimination. Such exposures, therefore, are associated with relatively acute onset and progressive symptoms. Cases of this sort are found in silica-crushing processes. Less severe exposures, such as in quarrying, are associated with later onset and more chronic course, while lead mining may lead to a much delayed onset. If the condition is recognised at a very early stage and the patient is removed immediately and permanently from the danger of dust inhalation, the amount of change produced in the lung may be less than is required to produce any degree of conscious disability. The first case cited under the paragraph "Symptoms" is an instance of the limitation of the disease process by timely removal from risk. It will remain to be seen how far the process of fibrosis in such cases can go after the source of irritation has ceased. So long as the condition remains one of uncomplicated silicosis, the progress is virtually dependent on the increase of dyspnea. Intercurrent catarrhs, which appear to be frequent, increase the dyspnea, and definite chronic bronchitis may be established, rendering the patient specially liable to exacerbations of an inflammatory character. Thus, in the case of Hugh Miller (23), who as a stonemason had been exposed to the dust of a very dangerous sandstone, "the stonemason's disease — the presence of particles of stone in the lungs — augmented the torturing irritation of repeated inflammatory attacks in this most sensitive organ" in 1855. A year later his wife, after advising him to consult his doctor, Professor Miller, tried to dissuade him from going out on account of the weather which was bitterly cold with drizzling rain: "You know that if you go out, you will bring on another inflammatory attack in your chest, and then I shall have done more harm than good."

From the onset of symptoms until death, the period of time which can be called the illness, varies widely. The reservation regarding the actual onset and the admitted onset must be kept in mind, as the latter only is available to the clinician. Longest in the stonemason series, the average duration of symptoms in 6 fatal cases among these workers was $6\frac{1}{4}$ years; in 12 lead miners, $3\frac{3}{4}$ years; in 8 silica workers, $3\frac{3}{4}$ years; in 4 scythestone makers, $3\frac{1}{2}$ years; in 5 quarrymen, $2\frac{1}{2}$ years.

From the admitted onset of symptoms in cases which end fatally, the illness may last, in this type of case, with more or less gradual increase of symptoms, from one year or less to seventeen years. In uncomplicated cases, death may result from pneumonia or influenza or from general

failure of the heart following on the respiratory embarrassment and loss of strength.

Silicosis with Tuberculosis. — The most important variation in the course of the disease is the occurrence of tuberculosis. While there is evidence that tuberculosis may co-exist with silicosis without producing any apparent alteration in the course of the disease, in the majority of instances, the development of tuberculosis is along a different line and produces definite evidences of its presence. In the earliest cases of silicosis, and especially in young subjects, the disease when first seen may be indistinguishable from ordinary tuberculous phthisis. The superadded disease has produced symptoms before the antecedent silicosis has developed sufficiently to demand medical attention — hence it is missed.

The influence of the two conditions on each other when existing together may, however, give some information, for, as has been mentioned before, the silicotic process is hastened in the presence of tuberculosis, and the changes due to it are unevenly distributed throughout the lung or lobe. Hence an access of activity in the course of silicosis with a development towards a tuberculous type gives an indication which is obvious enough. More and more such a case approaches the ordinary tuberculous disease as it advances, with the wasting, lassitude, pyrexia, night sweats and increase of cough and expectoration found in the common ulcerative chronic tuberculosis.

The occurrence of tuberculosis has the effect of carrying the disease to a fatal issue more rapidly than when this complication is absent. In fifteen cases in which tubercle bacilli were found in the sputum, the average duration from the onset of admitted symptoms was 3.17 years; in twenty cases in which tubercle bacilli were not found, the average duration was 4.62 years. The difference as stated is less than it should be as several cases of shortest duration in the latter group were certainly tuberculous, though no opportunity was obtained for sputum examination.

Dr. Brownlee (24) of the Medical Research Committee has made a recent statistical study of the epidemiology of phthisis, and he finds that the disease incidence presents three age groups, corresponding to early, middle and advanced life, the middle group being chiefly affected by environment. This middle-age group is that of the "accidentally phthisical," who in all probability would have got through life without succumbing, had it not been for the unfortunate conjunction of an injurious environment with a limited personal resistance, which gave way under the extra load.

Although it would be unsafe to attach much importance to any such grouping in the present instance, especially as the term "phthisis" in mortality statistics is made to bear so many interpretations, it is nevertheless worth noting that a majority of the early fatal cases of silicosis are complicated by a tuberculous process of a type which comes near to ordinary adolescent pulmonary tuberculosis in symptoms, course and physical signs. On the other hand, the picture of pulmonary tuberculosis in the middle-aged silicotic bears a strong resemblance, in the same particulars, to the industrial disease, pure and simple, in which no evidence of tuberculosis is found.

Dr. E. L. Collis (25) shows from statistics collected from the annual health report of Sheffield that, among ganister workers, who die at the average age of 39 to 40, "phthisis" accounts for from 75 to 84 per cent. of all deaths occurring between the ages of 25 and 55. Collis also gives the data from another official source to show that among sandstone dressers the mortality from "phthisis" is about half that of ganister workers of the same age, and that the average age at death is nine years greater.

The development of tuberculosis in the subjects of silicosis was believed to be determined by predisposition, and this opinion was expressed by Dr. Greenhow. There appears to be a relationship between the development of tuberculosis and a family history of this disease.

It might, of course, be argued that cases of pulmonary tuberculosis occurring in young persons exposed to silica dust are ordinary cases of that disease without reference to the industrial environment, and in some cases this may be so. It has been pointed out, however, by many observers, that the inhalation of silica dust predisposes to the development of tuberculosis, and it must be admitted that this baneful influence may have been at work in precipitating the onset of pulmonary tuberculosis, although no characteristic symptoms of silicosis had been observed.

Conclusions

1. Silicosis is caused by the inhalation of minute particles of dust of high silica content.

2. The finest particles are most directly injurious as they reach the lymphatic channels of the lung producing progressive fibrosis; the dust is most dangerous at the first moment of generation, before damping or agglutination has occurred.

3. The disease produced can be diagnosed from physical signs — in some cases before the patient has become aware of definite symptoms.

4. Silicosis predisposes to tuberculosis of the lung, as a result of the changes produced in the lung. It may, however, exist and prove fatal without any definite evidence of a superadded tuberculous infection.

5. The only means of combating the disease is by prophylaxis — in preventing the generation of dust at its source, in obviating its inhalation by the use of masks, and in excluding any affected persons when the condition becomes recognisable.

6. The prophylactic measures should be carried out in all industries where the inhalation of dust of high silica content is a contingent danger.

BIBLIOGRAPHY

1. Smyth, H. F.: A Critical Review of Methods for the Study of Dust Content of Air. Jour. Indust. Hyg., 1919–1920, **1**, 140.
2. Bill, J. P.: The Electrostatic Method of Dust Collection as Applied to the Sanitary Analysis of Air. Jour. Indust. Hyg., 1919–1920, **1**, 323.
3. Final Report of the Miners' Phthisis Prevention Committee, Pretoria, South Africa, 1919, p. 18.
4. Final Report of the Miners' Phthisis Prevention Committee, Pretoria, South Africa, 1919, p. 17, para. 44.
5. Royal Commission on Metalliferous Mines and Quarries, Minutes of Evidence, Vol. 3, Cd. 7478, p. 59. Wyman & Sons, Ltd., 1914.
6. Royal Commission on Metalliferous Mines and Quarries, Minutes of Evidence, Vol. 3, Cd. 7478, p. 145. Wyman & Sons, Ltd., 1914.
7. Mavrogordato, A.: Experiments on the Effects of Dust Inhalation. Jour. Hyg., 1918, **17**, 439.
8. Watkins-Pitchford, W.: The Gross Characters of the Silicotic Lung. Med. Jour. S. Africa, 1914–1915, **10**, 167.
9. Andrewes, F. W.: Annual Report Chief Inspector of Factories and Workshops, 1900, Cd. 668, p. 492.
10. Greenhow, E. H.: Stone-Worker's Pulmonary Disease. Trans. Path. Soc. Lond., 1866, **17**, 24.
11. Greenhow, E. H.: Specimen of Diseased Lung, from a Pearl-Shell Cutter. Trans. Path. Soc. Lond., 1870, **21**, 66.
12. Greenhow, E. H.: Specimen of Diseased Lung from a Case of Grinder's Asthma. Specimen of Coal-Miner's Black Lung. Trans. Path. Soc. Lond., 1865, **16**, 59, 60.
13. Andrewes, F. W.: Annual Report Chief Inspector of Factories and Workshops, 1900, Cd. 668, p. 493.
14. McCrae, J.: The Ash of Silicotic Lungs. General Report of Miners' Phthisis Prevention Committee, Pretoria, South Africa, 1916, p. 131.

15. Clark, *Sir* Andrew, Drs. Hadley and Chaplin: Fibroid Diseases of the Lung Including Fibroid Phthisis. London, 1894, pp. 44, 64.
16. Osler, *Sir* William: The Principles and Practice of Medicine. Sixth Edition, London, 1906, p. 632.
17. Watkins-Pitchford, W.: The Industrial Diseases of South Africa. Johannesburg, 1914, p. 35.
18. Haldane, J. S.: Text-Book of General Pathology edited by M. S. Pembrey and J. Ritchie. London and New York, 1913, p. 473.
19. Clark, *Sir* Andrew, Drs. Hadley and Chaplin: Fibroid Diseases of the Lung Including Fibroid Phthisis. London, 1894, p. 93.
20. Greenhow, E. H.: Third Report of the Medical Officer of the Privy Council, 1860, p. 144.
21. Oliver, *Sir* Thomas: Diseases of Occupation. New York, E. P. Dutton and Company, 1916, p. 280.
22. General Report of Miners' Phthisis Prevention Committee, Pretoria, South Africa, 1916, p. 104.
23. Bayne, P.: Life and Letters of Hugh Miller. London, 1871, Vol. 2, pp. 461, 472.
24. Brownlee, J.: An Investigation into the Epidemiology of Phthisis in Great Britain and Ireland, Part III. Med. Research Comm., Spec. Rep. Series, No. 46, London, 1920, p. 40.
25. Collis, E. L.: Industrial Pneumonoconioses, with Special Reference to Dust-Phthisis. Milroy Lectures (1915), p. 12. Pub. Health, 1914–15. **28**, 252.

BOOK REVIEWS

Industrial Housing. With Discussion of Accompanying Activities; Such as Town Planning — Street Systems — Development of Utility Services — and Related Engineering and Construction Features. By Morris Knowles, Sometime Supervising Engineer, Camp Meade, Maryland, and Camp M'Clellan, Alabama; and Chief Engineer, Division of Passenger Transportation and Housing, Emergency Fleet Corporation, United States Shipping Board; Member American Institute Consulting Engineers; Member American Society of Civil Engineers; Member American City Planning Institute; Member International Garden Cities and Town Planning Association; Member Town Planning Institute (Gt. Brit.); Member National Housing Association; Director, Dept. of Municipal and Sanitary Engineering, University of Pittsburgh. Cloth. Pp. 408 with illustrations and index. New York: McGraw-Hill Book Company, Inc., 1920.

Under this modest and possibly misleading title, Mr. Morris Knowles has succeeded in bringing within the compass of a single volume a connected treatise on municipal engineering in its modern aspects. With streets and pavements, water supply, sewerage and drainage, sewage treatment and disposal, collection and disposal of town wastes, and gas and electric service all comprehensively dealt with, the book may appeal at least as much to the large number interested in these subjects as to the more limited circle upon whom the housing question is pressing itself with ever increasing force.

Nor must it be supposed that the covering of this wide range of subjects has been effected by any lack of detailed treatment. Take, for instance, the discussion of street classification, pavement types and constructional methods; not only are the general principles admirably laid down, but concrete examples serve to show what can be done to meet diverse conditions. This applies also to the chapter on water supply, in which the elements of quality, necessary volume, and source of supply are treated with a completeness not always observable in separate essays. Special attention may be directed, in this connection, to the discussion of treatment methods, in which stress is laid upon the rapid growth of water filtration in the United States since 1870. In like manner, modern sewerage practice, involving to an increasing extent the separation of sewage from rainfall, is dealt with on sound principles and with an abundance of illuminating detail. The possibility of reducing leakage into pipe sewers — a too frequently neglected factor — is touched upon in references to the advantages of bituminous joint fillers over the rigid cement joint.

As regards housing, the book is largely indebted to the author's experience as supervising engineer in government camps in Maryland and Alabama and in other work during the war. A notable achievement of the U. S. Housing Corporation and the Housing and Passenger Transportation Division of the Emergency Fleet Corporation, of which division the author was chief engineer, is recorded in the erection of dwellings for more than 30,000 families at an aggregate cost of $183,000,000. Considerable space is devoted to a description, illustrated by numerous maps and plans, of what was thus accomplished. The benefits accruing from modern methods of industrial housing, including the reduction in labor turnover brought about by more settled residential conditions, are fully discussed. A review of the question of cost shows that, even with the obvious advantage of centralized control over extensive operations, dwellings of this kind entail an initial outlay of from $5000 to $6000 per family — figures excluding a total of $8111 per family in the case of the American Shipbuilding Company, Lorain, Ohio.

While the gravity of the financial problem appears to be adequately recognized by the author, we note the omission of any comprehensive discussion of the economic problem presented by the growing insistence upon state and municipal intervention in this field. Future editions of this work should include a reference to the leading example of such intervention, England and Wales, where the public exchequer faces an annual loss of $100,000,000 during the next sixty years as the result of subsidized housing.

On the other hand, the student will find invaluable data and suggestions in regard to town planning, the supervision of construction, and the administration of industrial towns. In these, as in other respects, the present treatise affords not only a demonstration of the growing importance of the subject dealt with, but a tangible proof of the skill and industry with which the results of modern experience have been made available for prospective efforts. — *John S. Hodgson.*

THE JOURNAL OF INDUSTRIAL HYGIENE

PUBLISHED MONTHLY

VOLUME II | APRIL, 1921 | NUMBER 12

THE CAMPAIGN AGAINST MINERS' NYSTAGMUS IN THE COLLIERY DISTRICT OF LIEGE, BELGIUM *

N. STASSEN, M.D.

Medical Officer to the Liège Collieries

IN 1906, in spite of numerous works published on the subject, our actual knowledge of the etiology and pathogenesis of miners' nystagmus was still very confused. In this same year, when giving evidence before a commission of inquiry, instituted by the Belgian government to investigate the conditions of work in mines, certain doctors went so far as to deny the industrial origin of the disease. In accordance, therefore, with an agreed policy, the Commission on Industrial Diseases for the province of Liège resolved to obtain the views of all the ophthalmic surgeons in Liège, of mining engineers, and of colliery doctors on the cause and extent of the malady. The results were, unfortunately, disappointing, so that on the advice of M. Liebert, then chief engineer of the Liège mines, I was deputed to make an extended inquiry among the collieries of the district with the object of ascertaining the frequency of nystagmus and ultimately of deciding its causation.

In carrying out this obligation, I received full authority and willing assistance from all the managing directors of the collieries and metalliferous mines in the Liège basin, and was thus enabled to examine: (1) the personnel of one iron mine; (2) the personnel of one zinc mine; (3) the personnel of one coal mine where naked lights (candles and lamps) are used; (4) the personnel of nineteen coal mines where oil and benzine safety lamps are used; and (5) the men on day shifts at six coal mines where the majority of the miners have used portable electric lamps for at least three years. As coming within the scope of my instructions, I likewise made an examination of the personnel of several slate quarries. The total number of miners examined was over 20,000, of whom over 8,000 were seen twice during one day—*viz.*, just before going down into the mine, and immediately on coming up after finishing the day's work.

In the course of the numerous descents into the mines which I had occasion to make, I followed the miner step by step from his entering the cage up to his commencing work; I familiarized myself with

* An address read at the Congress of the Royal Institute of Public Health held in Brussels, May, 1920, and translated for publication in the Journal of Industrial Hygiene with the consent of Dr. Stassen and the Royal Institute. Received for publication Sept. 28, 1920.

the way in which he manipulated his tools; I kept him under observation up to the moment when, his day's work being over, he returned to the surface. As the result of my experiences I have arrived at the conviction (confirmed by the great majority of English oculists who have specially studied the question, notably, our distinguished colleague, Dr. Lister Llewellyn) that the real cause of nystagmus must be sought, not in the upward look which the miner is compelled to adopt at his work, but solely in the faulty conditions of lighting at the bottom of the mine.

The conclusion arrived at, as the direct result of the inquiry, was that there exists among miners, working under faulty conditions of lighting, a fatigue of the visual apparatus which is ultimately transformed into a nervous syndrome, characterized by inco-ordination and exaggeration of ocular reflexes, and that occupational nystagmus, previously considered to be a well-defined morbid entity, is, in reality, only a pathognomonic symptom of overstrain of the centers controlling the muscular equilibrium of the eyes.

The inquiry proved that, of the 20,000 miners examined, 5,000 (25 per cent.) exhibited, in various degrees, definite signs of ocular fatigue (hemeralopia, defective retinal receptivity, nystagmus, blepharospasm). These 5,000 colliers with "visual fatigue" may be divided into five groups:

1. In 8 per cent. the ocular fatigue was temporary, the symptoms disappearing after twelve hours' rest;
2. In 12½ per cent. the ocular fatigue was slight;
3. In 3 per cent. the ocular fatigue was pronounced;
4. In 1 per cent. there was distinct ocular strain with an appreciable amount of diminishing occupational capacity;
5. Finally, 2 per thousand were found afflicted with a definite neurosis and psychic troubles, which incapacitated them from all work or at least from all work down the mine.

From the point of view of prophylaxis, it was proved (see Table 1) that attention must, above all, be directed to the better lighting of workings if we wish to combat effectually and to diminish the ill effects of visual overstrain in miners. The campaign against this occupational disease must, therefore, be carried on with two definite objectives: (*a*) to seek out the preventive measures which will render miners immune to attacks; and (*b*) to treat workers affected with occupational visual troubles.

Preventive Measures

We have seen that defective lighting of underground workings constitutes the necessary and sufficient cause of visual troubles among miners, and, reciprocally, that improvement in lighting arrangements has brought about a disappearance of these effects among workers in metalliferous mines. It is, consequently, upon improved lighting conditions in the workings that measures for the prevention of visual troubles among all miners must primarily be based. Though this improvement has been effected in metalliferous mines, the difficulties of working and the presence of inflammable gas, particularly fire damp, have, unfortunately, rendered similar results in coal mines less easy of attainment. The lighting of coal mines with naked lights is, as a matter of fact, impossible. It is useless to recall here the amount of work and experience which has been devoted to attempts at reconciling increased lighting in coal mines with the measures necessary to protect colliers against explosions. Laws and decrees govern minutely the lighting of coal mines, and neither managers nor workers can, without incurring very severe penalties, set aside these important safety statutes.

The question may be asked, however, whether there is not some way to be found,

in the actual method of lighting by safety lamps, whereby the light can be so improved physiologically as to do away with the evils which now ensue. Is it possible to augment the lighting power of the safety lamp and at the same time to give the light sufficient steadiness to provide a color agreeable to the eye, and to protect the sight from glare and flickering?

TABLE 1. — INFLUENCE ON NYSTAGMUS OF DIFFERENT VARIETIES OF SAFETY LAMPS

Method of Lighting	Illuminating Power Heffner Unit	Illuminating Power at End of Day's Work	Steadiness of Light	Color of Light	Discomfort from Glare	Severe Cases of Nystagmus per 10,000 Workers	Marked Cases of Nystagmus per 1,000 Workers	Percentage of Cases of Nystagmus among Workers on Regular Daily Shifts	Frequency of Nystagmus among Workers Using One Method of Lighting Exclusively during Occupational Career
Oil safety lamp	0.50	0.28	Flickering; affected by air currents and humidity	Reddish-yellow	Considerable, particularly at end of day	35	57	31	Very numerous
Benzine safety lamp	1.01	0.80	Flame fairly steady; flickering caused by draught	Yellowish	Considerable, particularly at end of day	12	41	21	Less numerous than among workers using oil safety lamps
Candles and lamps with naked lights	0.70	0.70	Flame affected by moving air and humidity	Yellowish	Noticeable when miner does not fix candle overhead	0	13	28	A few cases
Electric lamps with accumulators	1.75–2.00	1.50–1.75	Steady	White	Appreciable, but less severe than with other methods	8	12	15.4	No cases encountered; period of inquiry too short — should be followed up
Acetylene lamps	8.00–15.00	8.00–15.00	Steady; scarcely affected	White; agreeable to eye	None, owing to reflector	0	0	0	No cases

From several of these points of view portable electric lamps have made some progress, but their lighting power is still poor. Moreover, making every allowance for faulty construction and upkeep, their equality with safety lamps is not altogether agreed upon. In comparison with oil or benzine safety lamps, portable electric lamps present the great disadvantage of not warning the miner of the presence of fire damp, and in several dangerous collieries employing electric lamps it has been absolutely necessary to provide the colliers with an additional oil or benzine safety lamp as a gas detector, thus increasing to a marked extent the cost of lighting.

Under any circumstances, however — and this applies equally to safety lamps — certain improvements must be effected in the lighting at the bottom of the mine, and without jeopardizing the safety of the workers. It is, therefore, essential to filter the light given out by the lamps, or at least to shade the eyes of the miner from the glare and flickering of the flame. On

many occasions I have had an opportunity to note the good effect exercised on the vision of coal getters and overseers by the interposition of a small screen of parchment paper between the casing and the glass of the lamp. It should be very easy to bring this method of protecting the eyes into general use, as it is quite sufficient for screen purposes to dull a portion of the glass only.

With portable electric lamps one could have recourse to subdued globes. During experiments undertaken in the Esperance Collieries at Montegnée, I have observed that the subdued diffuse light from these particular globes was most agreeable, better to work with, and much less fatiguing to the eyes.

As touching on the same subject, I mention here the researches which were made in 1911 and 1912 on the underground personnel of the Hasard Collieries. In 1911, following out the view that visual troubles must be due to the over-brilliant glare of the yellow flame projected too powerfully on the white glass of the lamp, M. Henry, technical director of the Hasard Collieries, supplied all the workers of the Fleron pit with safety lamps fitted with uranium glass of a greenish-yellow shade. The light given out by these lamps was more pleasant to the eye than that of ordinary safety lamps, and the glare from the flame was less troublesome. The workers kept very well during the use of these improved lamps. Unfortunately, however, the war came to interrupt these experiments, which should be resumed at the earliest possible moment.

Treatment of Visual Troubles among Miners

In order to be in a position to provide for pitmen, affected with visual troubles due to their occupation, the amount and kind of care demanded by their condition, there was founded, in 1908, in the Rue St. Gilles, Liège, a clinic for miners' nystagmus, which, though primarily intended for treatment, became very soon a medical service for study of the disease also.

On the suggestion of the Committee on Industrial Diseases, the Provincial Council decided to take up the matter of providing pecuniary assistance to workers attacked with nystagmus. By the establishment of grants in aid for helping the local sick clubs (which, thanks to a tacit understanding between themselves and the colliery proprietors, had organized special departments for miners' nystagmus), a system of equitable indemnity was established. When a collier is obliged to give up work on account of nystagmus, the colliery company by which he is employed, or the sick club with which he is affiliated, pays him in the ordinary course a special sick allowance. In addition, a standing committee in Liège, thanks to the substantial grants placed at its disposal by the Provincial Council, supplements this allowance by an amount calculated on previous wages, family upkeep, etc. When incapacity ceases to be total, or if, on a medical certificate, the worker is declared incapable of resuming his former work, the province makes a fresh grant to cover the period of his partial disablement.

Finally, with a view to co-ordinating the efforts directed against miners' nystagmus, to seeking out the cause, and to securing for those affected the necessary medical attention, the province of Liège has organized a medical service to study the physiological conditions of miners' work and the biological troubles engendered thereby. This provincial service acts as a uniting element between the management and the workers. It makes a point of securing for the latter the provision of employment most suitable to the actual ocular conditions; on the other hand, it demonstrates to the management the proper hygienic

modes of diminishing insanitary conditions underground. Thus, by securing suitable employment for the workers and by improving sanitary conditions in the mines, the service endeavors to fulfil the mission entrusted to its care: "To improve the health and well-being of the courageous workers in Liège mines."

From 1908 to 1920 over 500 patients attended the miners' nystagmus clinic. They were not all incapable of work; indeed, many had their occupational capacity unaffected. On the other hand, it was not uncommon to find, stranded at the clinic, unfortunate workers who had succumbed to amblyopia and neurosis resulting from that nervous exhaustion which is an inevitable effect of the cumulative fatigue which severe cases of nystagmus impose upon the worker's nervous system through his efforts to finish the day's work in some fashion. It is to these industrial wrecks that the clinic has been most helpful, for, after many months of treatment, it has restored their health and frequently their full working capacity.

TETRACHLORETHANE POISONING AND ITS PREVENTION*

D. C. PARMENTER, M.D.

Assistant in Industrial Hygiene, Harvard Medical School, and Instructor in Hygiene, Harvard University

THE aim of this report is to define the initial symptomatology of tetrachlorethane poisoning, to point out the significance of the symptoms, and to discuss the best preventive measures to be adopted.

Tetrachlorethane (acetylene tetrachloride), a saturated hydrocarbon of the methane group, is a heavy, colorless, oily liquid, with a boiling point of 147.2° C. and a specific gravity of 1.6208 at 4°/4°. It is non-inflammable and has a sickish sweet odor suggestive of chloroform. It is used as a solvent for certain types of cellulose esters, dammar, sandarac, copals, etc.

During the war this substance rose to its present point of interest because of its use in some of the so-called aeroplane "dopes," or varnish with which aeroplane wings are painted. In this country it is being utilized for peace-time and commercial purposes in the manufacture of such articles as non-inflammable films, various lacquered goods, artificial silk, etc. Cellulose acetate is often used as a base and tetrachlorethane as the solvent. This country profited by the mistakes of the British and the Germans, and was protected from fatal cases of poisoning during the war chiefly through the use of good substitute solvents. In addition to the information learned from its war-time use, the increased care in its use in peace times has made tetrachlorethane an entirely feasible material with which to work. The somewhat meagre literature concerning its war-time use is made up essentially of reports from Jungfer (1), Grim, Heffter and Joachimoglu (2), and Koelsch (3) in Germany, Willcox (4) (5) (6) (7) in England, and Hamilton (8) (9) (10) in this country. From these sources we are able, however, to obtain an accurate idea of the symptomatology and pathology of severe poisoning from this substance.

The symptoms of poisoning are of two types, gastric and nervous. They are not usually combined but nervous symptoms may be preceded by gastric disturbances. The literature sets forth a typical case as beginning with general malaise, drowsiness at work, especially at night, loss of appetite, nausea, vomiting, morning retching, bad taste, constipation and headache. After a period of days or even weeks, there is jaundice with pale stools and bile-stained urine. Vomiting becomes worse. There may be confusion, stupor, delirium, coma, and death. Other not uncommon late symptoms may be petechiae, hematemesis, convulsions, and anuria. The clinical features particularly noted are the insidious onset, long duration of the acute stage, with intense jaundice — features which are important in the differential diagnosis from acute yellow atrophy, infectious jaundice, arsenic or delayed chloroform poisoning.

In discussing the pathology of tetrachlorethane poisoning, Willcox ascribes the jaundice to a cholangeitis set up in the smaller bile-ducts causing an obstruction to the flow of bile to the liver. There is present also a marked fatty degeneration of the liver cells which, in severe cases, is followed by necrosis of the liver cells and symptoms of autointoxication identical with those of acute yellow atrophy. If the patient survives the necrosis, then the affected area is replaced by fibrous tissue.

The observations to be here reported are on the general clinical aspects of tetrachlorethane poisoning in a plant making

* Received for publication Oct. 7, 1920.

artificial silk — a plant well adapted as to management, personnel, and control of the poisoning to illustrate the possibilities open for the use of tetrachlorethane in peace time. Special investigation of the blood of the workers in this plant has been made by Dr. G. R. Minot and Dr. L. Smith and is shortly to be reported. Ninety-five people were employed at various times over a period of five months, twenty of whom were women engaged entirely in the spooling of silk.

Of the six processes involved in the making of artificial silk there are only two — so closely related as to constitute one — which need concern us here. This procedure, that of spinning out the thread on spools and drying it, was found to promote the greatest exposure to tetrachlorethane, and, as a result, all except three of the more severe cases of poisoning were among persons engaged in this work. The process involved twelve men working in eight-hour shifts of four men each, and about six men working during the day in and near the same room. Observation for cases of poisoning occurred over a period of five months. During this time twenty-one cases of poisoning occurred, nine of which were of a degree that demanded temporary suspension of work. The other twelve were of a sufficiently mild degree to permit continuance of work, and after a time the symptoms disappeared. No fatalities occurred. In fact, nothing more serious in the way of poisoning was observed than that degree which warranted the doctor keeping the men from work from six to eight weeks. The two severer cases were not really serious, nor have they resulted in permanent damage, as the men are at the present time in very good health. It is well to note here that keeping men from work was a therapeutic and precautionary measure employed by the doctor in charge. Not one of the men was confined to his bed at any time; all were up and about and, in most cases, out of doors in the fresh air, which was markedly beneficial.

Symptomatology

The symptomatology of tetrachlorethane poisoning is the first and most important question for consideration. To give a clear idea of the successive stages of poisoning in the usual order of occurrence, an endeavor will be made to group the symptoms, pointing out the important ones, and in this way to present a composite picture of the typical cases. It may readily be understood that the earlier symptoms in such a picture often appear in an individual who is on the verge of mild infection or who is physically below normal. A description of these very early symptoms may seem like an attempt to divide what is often referred to as general malaise into its component parts. Nevertheless, for this very reason, these slight symptoms considered in detail are, from the point of view of prevention, the most important in the whole picture. In most cases exposed to tetrachlorethane in this work they are sufficient to give a diagnosis of incipient poisoning—a point which should be particularly stressed, since these early and vague general symptoms are merely alluded to in the literature. Going further than these first general symptoms we find the symptomatology as a whole falling roughly into three groups — general, nervous, and gastric symptoms — as shown in Table 1. In many cases, the gastric symptoms overlapped the nervous symptoms.

The general, or what might be called preliminary symptoms, alluded to as being of so much importance, consist in an abnormal sense of fatigue and a general discontent which passes as a continual "grouch" among the patient's friends. Associated with this is an inability to concentrate. A man will say that he cannot keep still, and that five minutes is long

enough to be doing any one thing. Profuse sweating on any exertion accompanies a feeling of being easily tired. Occasionally some nocturia or a slight polyuria is complained of by those who have never before been so affected. While belonging more specifically to the definite nervous and gastric groups of symptoms, complaints of distaste for food and a feeling of nervousness frequently occur along with the first vague general symptoms. Although the twelve cases, to which reference has been made, showed symptoms of an exceedingly slight nature, they were closely observed because of the importance of such symptoms. Since the men continued at work and the symptoms after a short time subsided, the cases are not included in the accompanying table. It is important, however, to emphasize the fact that the failure to understand the significance of these very slight symptoms may easily lead the observer to overlook early cases. Such an oversight may lead to a more severe poisoning necessitating cessation of work, and, in any event, precludes efficient prevention of the poisoning — a subject which will be taken up later.

Consideration of the nine more severe cases in detail shows that the general irritability and discontent appeared in all of the severe just as it did in the twelve mild cases. The sense of being easily fatigued occurred in eight out of the nine, and the inability to concentrate in six. Profuse perspiration as a symptom was marked in three cases, while nocturia and polyuria occurred in only one case each. Nocturia consisted in nightly micturition two or three times over a period of a week, and polyuria was noticed over a period of three or four days with micturition eight to ten times daily. With the exception of this nocturia and polyuria, any further description of the symptoms is unnecessary except to reiterate that, taken as a whole, these symptoms constitute a picture very similar to the general malaise already mentioned,

TABLE 1. — INCIDENCE OF SYMPTOMS IN TETRACHLORETHANE POISONING

	General Symptoms						Nervous Symptoms					Gastric Symptoms												
Number of Case	Easily Tired	Sweating Easily	General Discontent	Inability to Concentrate	Nocturia	Polyuria	Dreaming	Headache	Vertigo	Nervousness	Insomnia	Loss of Appetite	Constipation	Diarrhea	Gas in Stomach	Epigastric	General Abdominal Pain	Pain in Lower Abdomen	Pain in Right Upper Quadrant	Eructations of Gas	Nausea	Vomiting	Length of Exposure in Months	Severity of Case
1	+	+	+	+			++			++	+	++	+		+	+	+					+	2	Mild
2	+		+	+	+	+	+	+	+	+	+	+	+	+	+++	+		+		++	+	+	3	Severe
3	++		+	+			+			+	+	+	+								+		5	Mild
4	+	+	+	+				+		+	+		+		+					+	+		7	Mild
5	+	+	+	+			+			+	+	+	+		++	+	+			+			4	Mild
6	+		+				+	+		+		+	+								+		6	Mild
7			+	+			++			+	+	+	+		+	+	+						2	Mild
8	+		+					+	++	+	+	+	+			++	+	++	++	+	++	++	5	Severe
9	+		+					+		+	+	+	++		+	+				+		+	4.5	Mild

and for this reason may easily be overlooked and their importance not realized. These apparently simple complaints, together with the blood picture to be referred to later in the problem of prevention, are of primary importance although they are but briefly mentioned in most of the literature.

Perhaps next in importance are the nervous symptoms which, as a group, tend to appear somewhat later in the course of the poisoning than do the general symptoms described. They are complained of in detail as headache, weird dreams, loss of sleep, and a general feeling of nervousness which is noticed by friends as well as by the person suffering from the poisoning. These symptoms are the more intense manifestations of the initial symptoms and constitute, therefore, this separate and later group. General nervousness in the subjective sense and the excessive dreaming are often among the earliest signs noted. The actual loss of sleep comes somewhat later, and with still severer poisoning there is often exhaustion on slight exertion, or more especially vertigo on stooping or leaning forward from a sitting posture.

In analyzing the cases according to the group of nervous symptoms, we find, as shown in Table 1, that general nervousness appeared in nine cases, accompanied by varying degrees of insomnia in eight. Dreaming was noted in six instances and headache in five, while actual vertigo under the above-mentioned circumstances occurred in only two cases. These, it seems well to add, were the most advanced cases.

According to the literature, the third group of symptoms — namely, the gastric — precedes the nervous group. This is probably because in the more advanced cases considered the gastric symptoms were more prominent and had at the time of examination overshadowed the nervous symptoms which began early. Contrary to the impression obtained from some of the literature, it seemed to me that in general the nervous and gastric symptoms occurred together, somewhat in the relation described previously. The gastric symptoms represented the most advanced stage and constituted the most severe manifestations of poisoning which I observed, the cases in which they occurred being ones of clear-cut toxic jaundice. This again is in contrast to the literature in which the gastric symptoms constitute the mildest type of poisoning.

An analysis of the nine cases described in Table 1 shows that a loss of appetite occurred in eight, accompanied by a feeling of nausea — constant, except at night, in five. In six there was a sensation of fullness in the stomach; in five, gas with frequent eructations. The gas and eructations were nearly always much more distressing after the ingestion of any food, as was also abdominal pain, when present. In this group of cases an occasional diarrhea, six to eight times a day, was complained of, but more frequently the complaint was of constipation. Finally, in the two more advanced cases, there was vomiting and sometimes associated with it generalized abdominal pain. Vomiting occurred only twice in two cases, and in two others about once a day for two or three days. The generalized abdominal pain was noted in four cases. With greater poisoning this pain was localized in the lower abdomen as seen in two cases, while in one case it was localized in the right upper quadrant.

In summarizing, then, the typical case seems most likely to begin with general symptoms of abnormal fatigue, discontent, and the like, with general nervousness and loss of appetite. As the poisoning progresses, these symptoms are accompanied by nausea and, finally, vomiting with distressing abdominal pain and dizziness on stooping. The only exceptions encountered were two instances in which the onset was sudden with vomiting in the morning while

at work. Such symptoms were no more severe than the stage represented by nausea. In both cases the men became suddenly unable to work. Whether these were instances of a rare skipping of the preliminary symptoms or whether these men had kept something back when questioned for symptoms is unknown.

The duration of symptoms was primarily a question of the length of time a man remained at work after developing any suspicious signs. Sometimes he was allowed to remain to make sure that his symptoms were not due to the onset of some mild infection. At other times he was allowed to remain to see if his symptoms would grow more severe, or if they might not cease altogether. This was the situation with the twelve men whose symptoms were of so mild a nature that excuse from work was not deemed necessary. They improved and signs of slight poisoning disappeared after two or three days.

In mild cases with no progress of symptoms beyond the stage of loss of appetite and slight nausea, four to seven days' rest from work led to a cessation of symptoms, and in ten days to two weeks the men were back at work in good health again. None of these rests from work involved more than normal living at home with slightly less exercise than usual. Symptoms as severe as vomiting persisted for three or four days after stopping work; the symptoms then reverted to the general ones, which lasted for a week or two. In a month's time, the two patients who had developed severe symptoms were, by the doctor's advice, back at work. It is, therefore, clearly shown that cessation of work, and with it cessation of exposure, is the primary requisite for recovery. In general, the earlier the detection of poisoning the shorter is the duration of symptoms, and the smaller is the chance of a recurrence.

Symptoms of the severity observed in the nine cases reported in Table 1 had associated with them very few physical signs, from which it appears that the stage of poisoning associated with physical signs is much more advanced than any encountered in the silk plant under observation. This serves to emphasize anew the fact that the cases of poisoning which I have observed were much earlier and milder than those noted in the literature where physical signs were regarded as being of great importance. In the early stages — all except two of my cases are included in this period — the signs were few, consisting chiefly of a loss of weight and a very slight jaundice. The loss of weight varied from 5 to 15 pounds over a period of time from two weeks to two months and usually preceded the appearance of jaundice. The jaundice at this early stage is not of the severity commonly indicated by the term jaundice. It is not sufficiently severe to cause bile to appear in the urine, and is generally noted only as a very slight yellow tint in the sclerae. It may or may not appear with the early general symptoms. It usually does appear, however, shortly before the gastric symptoms, and with close observation may sometimes be detected when the patient complains only of nervousness, with the loss of appetite and of sleep. With the onset of the more severe symptoms the jaundice may extend to the skin of the face and chest. Yet even in such instances bile did not appear in the urine. This jaundice is significant in that it gives a rough estimate of the amount of liver involvement.

In the analysis of the nine severer cases a very slight jaundice appeared in all except two. In the twelve milder cases in which the patients did not have to stop work, slight degrees of jaundice appeared in all except one. The natural inference from these exceptions is that the poisoning developed too rapidly for the jaundice to appear in the initial stages. It is well to emphasize here that under ordinary circumstances this jaundice of the sclerae

might easily pass unnoticed, as in these cases only a very slight yellow tint was noted. It is, nevertheless, to be considered significant. Associated with the severer symptoms of abdominal pain, etc., there is also a general abdominal tenderness and occasionally, on examination, the liver may be found enlarged. In only one case, however, was the liver found definitely enlarged. This case showed also markedly localized tenderness. From these signs it may, therefore, be concluded that jaundice and loss of weight are the earlier physical indications of poisoning.

This conclusion contrasts especially with the literature in which much stress is laid upon liver enlargement and tenderness as frequently occurring physical signs. My own observations, in all cases but one, detected poisoning early enough so that no signs of this nature could be elicited. The lack of physical signs affords some proof of the ease of detection of poisoning prior to a severe stage. The physical signs are at best, however, evidence which is useful only when taken together with the symptoms and the blood findings, both of which are distinctly of much greater importance than are the physical signs. Proper observation and interpretation of the symptoms and blood findings together constitute the most effective means for prevention.

A laboratory finding which is of questionable value is the very dark and reddish urine coincident with the occurrence of the preliminary symptoms. On adding nitric acid, I detected a light violet ring at the junction of the two liquids. This would, of course, constitute a test for bile which, in turn, is indicative of the disturbance of liver function. It was, however, not sufficiently marked to be a definitely abnormal sign, but suggests the possibility of developing by further study a test in the urine of value in the detection of tetrachlorethane poisoning.

The laboratory finding of primary importance, second hardly to the importance of symptomatology, is the appearance of the blood. The blood picture in these cases, if the poisoning has reached the stage of detection by symptoms, is very striking. Its significance can perhaps be most comprehensively explained at this point by referring verbatim to the work of Minot and Smith. Their views on the importance of the blood picture and its interpretation in these cases are as follows:

"1. Blood examination is unquestionably of value in the prevention of tetrachlorethane poisoning, and in the diagnosis and prognosis of poisoning by this substance.

"2. None of the cases presenting clinical symptoms of tetrachlorethane poisoning (twenty-one in number) occurred without characteristic blood abnormalities, which may be observed before clinical symptoms develop.

"3. The blood abnormalities include: (*a*) a progressive increase of large mononuclear cells, often reaching 40 per cent.; (*b*) the appearance of many immature large mononuclears; (*c*) a slight elevation in the white count; (*d*) a progressive but slight anemia; (*e*) a slight increase in the number of platelets.

"4. A percentage of large mononuclear white cells above 12 is the first sign of a reaction to tetrachlorethane and is a signal for close observation of that person. All persons with such a picture do not necessarily develop clinical symptoms of poisoning.

"5. The presence of a considerable number of young mononuclears is to be looked upon as indicating a severer condition than a case with the same number of more mature large mononuclears.

"6. Practical utilization of blood examinations in connection with careful clinical observations has shown that these examinations are necessary for the regulation of the employment of workers and of the

assignment of work to men likely to be exposed to tetrachlorethane."

With these observations and the amount of emphasis laid upon the earlier stages of poisoning as shown by the symptoms and the blood findings, comes the question of the proper interpretation of such observations. Upon this interpretation, upon the efficiency of the engineering, and upon the watchfulness of the management depends the prevention of poisoning. In the particular plant in question, however, the intelligent and watchful supervision of the men by the management simplified considerably the medical side of the problem. The managing force had a clear idea of the symptomatology and saw to it that the men did also. It was found that direct and leading questions were necessary to elicit information and the utmost frankness was demanded of the employees in reporting immediately any abnormal feeling or sensation. This helped materially in locating very early the few cases which occurred. Some detail in this regard is included in the consideration of prevention. In interpretation of the data collected, it is important to consider the whole picture together rather than any one part alone, especially the blood or the symptoms. Of the interpretation of the blood picture sufficient has been said by Minot and Smith. In order to observe and interpret symptoms properly as a part of the whole picture, it is important to have medical supervision of a fairly exact sort.

The plan of general medical supervision would be somewhat as follows: On employment a routine physical examination should be made to determine a man's state of health, to observe his appearance, and to learn, if possible, his susceptibility to tetrachlorethane. This physical examination should include blood and urine examinations, the former, as stated by Minot and Smith, being valuable at this time to determine a man's normal cell count. By way of routine, the doctor should be able to see the employees two or three times a week and should question directly for any possible symptoms. The foremen should be acquainted with the preliminary symptoms and should report to the doctor for further questioning and observation any of their men showing these symptoms. A blood smear should then be taken and a careful watch kept of the patient's blood. Any man developing early symptoms lasting from two to three days should be excused from work for several days, during which time he should report to the doctor once or twice. The symptoms displayed, together with the length and severity of exposure, should be considered as a basis upon which to determine the length of time a man should remain away from work.

Prevention

Briefly, a person suffering from a mild case of tetrachlorethane poisoning, with loss of appetite and sleep, and with general nervousness for two or three days, should have his blood examined, and if that is abnormal he should be laid off for a time not exceeding a week. This should be done independent of the appearance of jaundice. On his return, he will probably be able safely to continue work at the plant. A still milder case with vague general symptoms and previous loss of weight should be watched carefully, but unless the blood picture suggests more severe poisoning than do the symptoms, work may safely be continued under observation.

In the case of more severe poisoning with abdominal pain in addition to the milder symptoms, the man should be excused from work immediately and should later have his blood examined. He will probably show jaundice. The time of return to work depends upon the progress of symptoms and upon medical observation—in the ordinary case, probably after two to three weeks'

absence. A case with sudden onset of vomiting accompanied by severe pain and much gas should be excused immediately. It is advisable for a person so affected to get other work if after his return there appears the slightest tendency to develop symptoms again. Undoubtedly, it would be better for him to give up this sort of work indefinitely, or to discontinue it for at least three or four months. At the end of that time, his possible return with exposure to tetrachlorethane can better be decided upon. Two mild attacks due to poisoning should lead the employer to get the man other work outside the plant. As a rule, any attack of poisoning of the severity last mentioned should prevent a man from returning to the same work.

These remarks will suffice to show the general method of interpreting symptoms, upon which prevention of the poisoning is, of course, primarily dependent. It is also dependent on our ability to discover and to eliminate the susceptible individual as well. This elimination of the susceptible makes the process of selection of employees important and consequently emphasizes perhaps more than usual the importance in industry of the preliminary physical and laboratory examinations.

In regard to susceptibility, observation has shown that the older man of perhaps 40 years or more does not resist exposure to tetrachlorethane as well as does the younger man of about 20 years. The only exceptions to this are cases of older men now employed who appear to have built up some form of resistance to the poison in the course of a long exposure. In addition to this, there is some reason to suppose that tetrachlorethane is absorbed through the skin. Some of the younger men of about 20 years with delicate skin have been thought more susceptible — a supposition which is, of course, somewhat hypothetical. With this in mind, however, care has been taken by the management of the silk plant under observation to have the men wash their hands in glycerine on leaving the plant and before meals. This has stopped some skin eruptions said to have existed before the present medical supervision was undertaken. What effect exposure has upon a man who has been poisoned once and who returns to work after employment elsewhere for five or six months, is not known. No chance to observe such a case has yet offered itself.

This outlines the main principles of prevention of tetrachlorethane poisoning from the point of view of interpretation of symptoms and laboratory findings as well as from the point of view of selection by the elimination of the susceptible. The personnel necessary for following these principles and the records used are still in the experimental stage, but it is hoped that they may be incorporated later in further observations on tetrachlorethane poisoning. They would, of course, necessarily vary with the enlargement of the plant.

The third item of importance under prevention is largely a matter of engineering, involving the proper enclosing and ventilating of hazardous processes. All possible care in this respect has been taken by the management at the silk plant investigated. Nevertheless, many things have had to be learned experimentally and much improvement in ventilation has been made in the last six months. In the more exposed processes in manufacture, powerful suction drafts pulling the air downward have been introduced. The spinning process has been almost entirely enclosed. The process of solution of the cellulose acetate has been put into a separate room and the men wear masks whenever working there. Masks are also worn by men working with acetic anhydride and prevent much discomfort although the substance is not particularly dangerous. It has been noticed during hot weather that heat renders the fumes of tetrachlorethane more diffusible and makes

the liquid itself more volatile. During hot weather, therefore, the men are doubtless more subject to the effects of exposure. Refrigeration of the spinning room, were such a thing possible, would, for that reason, be very desirable.

In general, then, prevention of tetrachlorethane poisoning, in so far as it presents an opportunity for engineering skill, is entirely a matter of enclosing as far as possible the various processes and, in addition, of using suction drafts as well as forced currents of air which will carry the tetrachlorethane (which is heavier than air) downward and out of a room rather than diffuse it as occurs in attempting removal by any other method.

Lastly, as a help in prevention, general measures are necessary, such as the regulation of working hours and adequate vacations, eating lunches away from contact with tetrachlorethane, the use of special clothes while at the plant, and, finally, any general sanitary supervision of drinking water, lavatories, and the like.

In conclusion it may be said that after having observed the action of tetrachlorethane in the making of artificial silk, I am quite convinced that cases of poisoning therefrom need not reach such a degree of severity as did the cases resulting from its war-time use mentioned in the literature. The poisoning can be detected very early. It seems fairly certain that a definite change, running parallel with, or perhaps preceding the symptoms, has been noted in the blood.

Proper engineering and intelligent management, then, seem sufficient or nearly sufficient for adequate medical control. Much has been done in the prevention and the confining of fumes from tetrachlorethane by methods generally covered in the term engineering. Perhaps more important, however, is intelligent management by men who understand and execute the necessary preventive measures. What may be accomplished through careful supervision has been shown in the silk plant under observation. Both the medical supervision and the mechanical preventive measures can doubtless be improved by further study and it seems reasonable to expect that cases of poisoning other than those of extreme mildness can be entirely prevented.

Summary

1. Symptoms of the very early stages of tetrachlorethane poisoning can be detected with careful observation. They are often not marked and consist of general gastric and nervous disturbances.

2. The proper interpretation of the early symptoms, together with a clear understanding of the importance of the blood findings, will make possible the prevention of all but the very slight cases of poisoning.

3. From these observations it seems justifiable to conclude that tetrachlorethane is an entirely feasible material with which to work commercially — in fact, no more difficult to use than benzol, trinitrotoluol, and lead.

BIBLIOGRAPHY

1. Jungfer: Tetrachloräthanvergiftungen in Flugzeugfabriken. Zentralbl. f. Gewerbehyg., 1914, **2**, 222.
2. Grim, V., Heffter, A., and Joachimoglu, G.: Gewerbliche Vergiftungen in Flugzeugfabriken. Vrtljschr. f. gerichtl. Med., 1914, Series 3, **48**, Second Supplement, 162, 191.
3. Koelsch, F.: Gewerbliche Vergiftungen durch Zelluloidlacke in der Flugzeugindustrie. München. med. Wchnschr., 1915, **62**, 1567.
4. Willcox, W. H.: A Fatal Case of Poisoning by Tetrachloride of Ethane. Lancet, 1914, **2**, 1489.
5. Willcox, W. H.: An Outbreak of Toxic Jaundice Due to Tetrachlorethane Poisoning. A New Type amongst Aeroplane Workers. Lancet, 1915, **1**, 544.

6. Willcox, W. H.: The Treatment of Toxic Jaundice Due to Tetrachlorethane Poisoning. Brit. Med. Jour., 1916, **1**, 300.
7. Willcox, W. H., Spilsbury, B. H., and Legge, T. M.: An Outbreak of Toxic Jaundice of a New Type amongst Aeroplane Workers. Trans. Med. Soc. London, 1915, **38**, 7645.
8. Hamilton, A.: Industrial Poisoning in Aircraft Manufacture. Jour. Am. Med. Assn., 1917, **69**, 2037.
9. Hamilton, A.: Dope Poisoning — A New Industrial Hazard in the Making of Airplane Wings. Survey, 1917–1918, **39**, 168.
10. Hamilton, A.: Industrial Poisoning in Aircraft Workers. Internat. Assn. Med. Museums, May, 1918, Bull. No. 7, 97.
11. Lehmann, K. B.: Experimentelle Studien über den Einfluss technisch und hygienisch wichtiger Gase und Dämpfe auf den Organismus (XVI–XXIII). Die gechlorten Kohlenwasserstoffe der Fettreihe nebst Betrachtungen über die einphasische und zweiphasische Giftigkeit ätherischer Körper. Arch. f. Hyg., 1911, **74**, 1.
12. Barlow, F.: Dope Poisoning. Med. Press and Cir., 1916, **152**, 471.
13. Lee, W. E.: A Fatal Case of "Dope Poisoning." Lancet, 1916, **1**, 24.
14. Poisoning by Tetrachlorethane. Editorial, Jour. Am. Med. Assn., 1915, **64**, 766.
15. Smith, W. S.: Doping in Aircraft Works. Ann. Rep. Chief Inspector Factories and Workshops for 1917. H.M. Stationery Office, 1918, p. 18.
16. Smith, W. S.: Doping in Aircraft Works. Chem. Trade Jour., 1918, **63**, 44.

DISCUSSION OF PUBLIC HEALTH BULLETIN NO. 106, COMPARISON OF AN EIGHT-HOUR PLANT AND A TEN-HOUR PLANT

A. H. RYAN, M.D.

Director, Industrial Hygiene, Scovill Manufacturing Company, Waterbury, Conn.

The writer has been hesitant in considering the publication of the present discussion of Bulletin No. 106 of the United States Public Health Service because of his relation to the investigation. Regarding this, he may say that he was not directly connected with the portion of the field work which forms the basis of this report, and that the investigation covering the 8-hour plant was completed before he became a member of the Committee on Industrial Fatigue of the Council of National Defense. This committee has not met since the preparation of the report. His relations to industry, however, are such that he is impelled to interpret and evaluate from the standpoint of its practical applications not only the material in the report under consideration, but anything which may appear to have a bearing upon the selection, efficiency, upkeep, and welfare of the human being in industry. Since the question of the most efficient working day is one of the important problems in this connection, and one which forms the subject of his own research, he has no choice than to accept the conclusions arrived at in this report or to analyze the report and decide upon its merits on the basis of such an analysis.

The present article has been written entirely as a criticism of certain conclusions as based upon certain presented data. This is not to be taken as a document in favor of the 10-hour day as against the 8-hour day, or for or against any particular length of working day, but as an inquiry into the character and use of certain presented facts to determine whether or not they justify the conclusions drawn from them. The science of industrial physiology is a new science, and the chief work to be done in the beginning is the development of technic. By criticism, technic is perfected. If, therefore, this communication is to serve the writer's purpose, it will be a contribution to the technic of industrial physiology.

The conclusions reached in Public Health Bulletin No. 106, *Comparison of an Eight-Hour Plant and a Ten-Hour Plant*, are briefly summarized on page 26 as follows: "A comparison of the 8-hour and 10-hour systems leads to the conclusion that the 8-hour system is the more efficient." Evidence for this is found in the decline of the hourly output at the 10-hour plant, as compared with its steady maintenance at the 8-hour plant; the greater amount of lost time and the greater amount of artificial limitation of output at the 10-hour plant; and the higher accident risk due to fatigue which accompanies the decline of working capacity at the 10-hour plant.

No clear statement is made as to just what is meant by the word efficiency as it is used in the summary of conclusions. The character of the evidence leads one to suspect that it is used in a very narrow sense, while, on the other hand, the purpose of the investigation as stated in the introduction of the report suggests the broader and usual conception of the word efficiency. To quote from the introduction: "With the entrance of the United States into the war the old problems of industry and labor suddenly changed. Industrial working capacity ceased abruptly to be a private concern; production became a public interest of the first consequence. . . . To attain maximum production without prejudice to national vigor — this was the new and enlarging demand of the time. . . . Under such circumstances and with a view to contributing to the solution of these vexed problems of industry, an investigation into certain industrial conditions was begun in July, 1917, by the Federal Public Health Service. . . ."

In view of the fact that only two plants have been studied, the comparison will be limited by the writer to two plants rather than to two systems. In comparing the two plants with regard to the four points enumerated above, the simple study of a number of jobs in each shows lost time and stereotyping to be more prevalent in the 10-hour plant, but no evidence is presented to indicate whether these are sufficient to reduce the production to that which would be obtained under an 8-hour schedule. A complicated procedure has been adopted regarding the other two points. An hourly index of production for each plant as a whole has been

obtained. Since the two plants make a different product, this is achieved by a common classification of the occupations in each plant and a study of representative operations in each class, from which an average is obtained. The hourly record of accidents is also obtained, and this, with the hourly output indices, makes it possible to obtain hourly ratios of accidents to production.

Even if the hourly output indices and the hourly accident risk indices could be admitted, the writer would maintain that the report had not gone farther than to compare the various hours with a particular hour in the same plant. But many objections must be raised to the methods of obtaining these indices and to the interpretation of them, and the points in question will be presented under the following heads: (*a*) criticism of methods employed in determining output and accident risk indices; (1) classification of occupations, (2) representation within classes, and (3) accident risk in terms of production; (*b*) discussion of evidence presented as indicative of relation of length of working day to indices; (*c*) criticism of indices used as measures of efficiency.

Criticism of Methods Employed in Determining Output and Accident Risk Indices

Classification of Occupations. — The method employed to obtain the hourly output indices was, first, to classify the occupations into definite groups or types, and, second, to record the hourly output of representative jobs of each group. After having obtained the average hourly output for each job, hourly indices were derived by giving to the hour of maximum production a value of 100.0 and determining for each of the other hours their corresponding value according to the following formula: $\frac{\text{actual output for hour}}{\text{actual output for maximum hour}} \times 100$. Four types of work were formed common to both factories, each of which was given equal weight in obtaining the output indices for each factory. These groups were designated muscular work, dexterous work, miscellaneous machine work, and lathe machine work. Thus, after obtaining the hourly output indices for each group, the average for the four groups was obtained, giving the representative hourly output indices for each factory. The importance of inquiring into the method of classification and of representation within each class is at once obvious.

It must involve, first of all, an occupational census of each plant in order to determine the jobs and the number of workers engaged on each. Such a census was taken at the 10-hour plant, but the classification of occupations in the 8-hour plant was based upon one made by some one else in a similar industry located in another city (see page 73). This would hardly satisfy the reader that the jobs had been sufficiently studied to warrant classification and to permit of the selection of representative jobs. An automobile plant, as is well known, may sublet contracts for parts, and may do a greater or less amount of assembly before shipment.

The only explanation one obtains in attempting to find a justification for a classification, upon which the entire comparison of the two plants as regards output and accident risk depends, is the following assertion: "Following Florence's plan, the operations were classified under four main heads: dexterous handwork; muscular handwork; machine work on lathes; and miscellaneous machine work" (page 28). The report continues: "This classification is admittedly more or less rough; in some of the types, as is pointed out in the text, the operations grouped together are not all strictly homogeneous; yet they are all properly representative of their types, owing either to the common physical requirements they make of the workers or to use of the same general type of machine."

It is doubtful whether we can achieve a classification which will permit of a comparison of different groups of workers unless it is made on the basis of a study of the physiologic requirements of the component jobs. Such a classification must take into account both quantitatively and qualitatively the afferent stimuli, the motor response, and the secondary associations in the central and sympathetic nervous systems. Over two years ago the writer undertook such a classification, and became convinced that it will be workable only after prolonged study. In the report the idea followed seems to have been that the muscular handwork consisted of all heavy muscular operations; the dexterous handwork, those operations which required dexterity; but in the third and fourth groups the classification was based upon types of machines. It is not, then, strictly speaking, an attempt to classify the operations physiologically, and as far as a mechanical classification is concerned, it is difficult to understand how, from its very na-

ture, the class described as "miscellaneous" machine operations may be considered a definite entity which permits of comparison in two different plants.

In attempting any classification of occupations, the natural assumption would be that each large group or class of occupations so formed would consist of a number of jobs more or less homogeneous. This assumption is admitted on page 137, as follows: "Moreover, to insure fairness of representation within the several types, the operations whose output curves are to be components of the group curves must be both typical of the group and proportionate to such subdivisions as may compose it. These conditions are fairly met in the case of the dexterous and muscular groups; the groups are fairly homogeneous and the operations studied are as representative as the range of selection allowed." Then follows a footnote: "Representation in these groups was limited, however, by the fact that only repetitive operations producing a uniform unit of output could be used for this study." It is difficult to follow this type of reasoning. If representation in these groups was restricted because of limitations in the opportunities for making output studies owing to the character of the work, by what process have the authors arrived at the conclusion that "these conditions are fairly met?"

We are not presented with a job analysis or descriptions of the jobs falling into the various groups except in a few sample cases, general descriptions of which are given, and the only data before us are the output curves. According to the authors there is a typical curve for each type of work. To quote from the report: "Thus, for example, work requiring attention and dexterity presents one general type of curve; heavy work requiring muscular exertion, another; and so on. Various typical curves may be thus distinguished" (page 29). But the hourly output curves cannot alone serve as the basis of a job classification since there are striking differences between the curves of the jobs included in a given class. We could not, in other words, on the basis of the hourly output curves alone, group the various jobs into the classes adopted in the report. If, then, dissimilarity exists in the hourly output curves for the different jobs studied within a group, we have reason to believe that even greater dissimilarity may exist in jobs not studied, especially since the very character of the work admittedly made it difficult to obtain output statistics.

There is another condition which must be considered in any classification of occupations upon which hourly output curves are to be based. This is found whenever a worker, falling from the nature of his work into one group, works in a battery, or assists a worker falling in an entirely different group, the result being that the output of one is influenced by the output of the other. To give examples of such an occurrence in the report, we have the case of machine helpers being classed as laborers under the group of muscular work. In the case of fuse assembly the hourly output is the output of an entire battery of several hundred workers, in which there are certain operators engaged in hard muscular work, such as tightening bottom closing screws, while the output is grouped under dexterous handwork. As regards the effect of this complication upon the material of the report, in the latter instance it would be the output curve of dexterous work, in the former, the accident risk for muscular work, which would be affected, since the accident tabulation for muscular work included accidents of the machine helpers. If, furthermore, as the report indicates, the output curve in the last hours is lower in muscular work than in machine work, then we should have in this type of muscular work an artificially fast pace set by the machine operation, on the one hand, and a retarding of the machine output on the other.

Still another objection to the methods of classification, so far as it is possible to discern them, is that certain jobs have elements corresponding to different classes; for example, the job known as footpress assembly is listed under muscular handwork. It is true that the footpress portion of the job employs a large muscle group of the lower limb, and considerable muscular tension; on the other hand, the assembling portion of the work involves several movements of the fingers, hands, and arms, requiring great manual skill, before the footpress lever is operated. It is difficult to see why the authors preferred to class it according to its "muscular" aspect rather than according to its "dexterous" aspect. This is important, as the output curve for the muscular handwork group at the 10-hour plant is based upon the study of only four jobs, on which only 153 workers were engaged, and on the strength of their classification they take this curve to be representative of the output of approximately 4,250 workers.

Again, the accident statistics on muscular work are based upon a study of three jobs — the work of laborers, truckmen, and utility men — which are entirely different jobs from those upon which the output studies were based. No attempt has been made to show that the hourly output of laborers, truckmen, and utility men is similar to that of the repetitive operations referred to above, nor to determine whether the hourly accident rate for these repetitive operations is similar to the ratio for laborers, truckmen, and utility men. They were all classed as muscular work, however, and the assumption is made that the data from one sub-group may be taken as representative of the other. It is obvious, therefore, that the classification of occupations is not shown to be adequate for the use to which it has been put.

Representation within Classes. — Let us now turn from the classification to the jobs which have been studied as representative of the classes, so that we may know what proportion of the factory population was included. In the first place, we are impressed with the small number of jobs representing each class, and, in some instances, with the small number of men studied as representative of the job. For example, at the 10-hour plant, in muscular handwork only four operations were studied; in miscellaneous machine work, three operations; and in lathe machine work, two operations. For the 8-hour plant, we likewise find large groups represented by only a few operations. In certain instances we find jobs in which the output curve is based upon the study of only one man (see straighten bell, and excavate, page 44). In the case of ramming molds, occurring in the same occupational group, the curve is based upon the study of only four men — and these were men working in a battery, or unit group. The output indices for three out of five jobs constituting the muscular group in the 8-hour plant are, therefore, based on the study of only six men, while this group represents several thousand men.

The study of two jobs as representative of a group might be held justifiable if a very large number of the workers within the group were engaged upon the jobs studied. Otherwise, conclusions based upon the study of such a small number of jobs are certainly questionable, and the more so when based upon only a few individuals. To justify such a small job representation, the number of workers engaged upon each operation should be indicated. It is impossible to obtain this information for all the four types of work, but in the case of muscular handwork at the 10-hour plant definite figures are obtainable.

It is stated that, according to a census of occupations taken in 1918, 35 per cent. of the total working force was engaged in dexterous handwork, 40 per cent. in muscular work, and 25 per cent. in machine work (see page 137). On page 139 each of the three types of work is given a value of $33\frac{1}{3}$ per cent. in the total occupational census of the factory. With a working force, then, of approximately 13,000 people, there would be about 4,250 people engaged in muscular work. In arriving at the output curve for these 4,250 people, four jobs were studied (see page 50) — planish seat, retap top cap, footpress assembly, and graduate train ring. Footpress assembly, as has been shown, requires considerable dexterity, and thus occupies a questionable place in this class. It is definitely known that the greatest number of people ever employed in the plant on these four jobs was 153, distributed as follows: planish seat, 4 men; retap top cap, 15 women; footpress assembly, 130 women; graduate train ring, 4 men. Thus, only 153 workers out of 4,250 employed on muscular work were represented by the jobs studied — a representation too small to be characteristic even in the absence of other objections.

The next question which may be asked is whether the character of the jobs studied is representative of the plant as a whole. We are led to question this from a consideration of the sex of the workers, the average wage, and the type of the jobs. As regards sex, at the 10-hour plant most of the jobs studied were those upon which women were engaged, whereas the opposite was true at the 8-hour plant. One would expect that the proportion of jobs studied, upon which women were engaged, would correspond approximately to the proportion of jobs in the plant as a whole in which women were employed. It is stated (page 20) that the women at the 8-hour plant constituted scarcely more than 1 per cent. in the manufacturing departments, while at the 10-hour plant about one-fourth of the total force were women. The output curve of the 10-hour plant is based upon a study of sixteen operations. Of these sixteen jobs, women were employed exclusively on eleven, or $68\frac{3}{4}$ per cent. of all the jobs studied, whereas they constituted only 25 per cent. of the total working force. Without definite evidence it is not justifiable to conclude either that

the work upon which women are engaged, or their output curve, is similar to that of men.

As regards wages, the following statement is made on page 164: "With long hours of labor and low wages, averaging, even in 1918, piece rates of \$3.20 per day for men and \$2.80 for women, it is not surprising to find the turnover at this plant nearly six times as high as at the eight-hour plant, that is, 176 per cent." As a matter of fact, the average wage at the 10-hour plant during that period was considerably higher both for men and for women than the figures given in the report, being, according to the management, above \$4.75 for men and \$3.25 for women for the productive occupations. This does not include the skilled trades, machinists, and tool makers. Further investigation reveals the fact that apparently the wage indicated was not the average for each sex in the plant, but rather the average for each sex in the groups studied. If, then, the output curves rest upon a study of workers receiving a wage which is lower than the average wage of the plant, the suggestion at once occurs that the groups studied were not representative, but may have been below the average either as regards their quality as workmen or as regards the skill requirements of the jobs on which they worked, casting still further doubt upon the output curve for the plant.

As regards the type of work, it should be clearly pointed out that the entire output study was confined to a limited group of repetitive operations. Only those operations were studied in which there was the greatest uniformity in every step, from the raw material to the final product. Obviously variations in uniformity would affect the hourly output curve in an extrinsic way, and such a curve would not indicate "working capacity." Again it was necessary to omit those jobs in which the units of output per hour were too small to give a reliable index of the amount of work done, and those in which the product was such that it could not be conveniently measured each hour. There are many such operations in the foundry and rolling mill. A large group of maintenance departments, such as millwright, power transmission, trucking and transportation, packing, pipe and steam, tool and machine, etc., are also eliminated by the above considerations. The admitted difficulty of obtaining greater representation in the operations of the muscular group may be more readily understood when one recalls that uniformity and repetition are the features which make it possible to adapt a job to machine operation, as well as to make it suitable for hourly output studies. It is only when special sensory discriminations are required that muscular power is used in preference to steam or electrical power. (This, of course, leaves out of account the small orders for work which would not justify the expense connected with making machine tools.)

The writer does not agree that an investigation of the hourly working rate (which is preferable to the term working capacity used in the report) must be necessarily confined to the limited group of repetitive operations studied. There are at least two other means of investigation available: one, the effects of the work on the physiological function or state; and the other, the energy expenditure, or oxygen consumption, throughout the day. By such methods, it would be possible to arrive at hourly indices of working rate even in non-repetitive operations of the ordinary sense.

Accident Risk in Terms of Production. — The hourly accident risk has been determined by obtaining a record of the distribution of the accidents in each hour of the day and dividing the index representing the relative number of accidents in each hour by the index of production previously discussed. Obviously such an index will have no greater accuracy than the accident and production indices. The trustworthiness of the output indices has already been discussed. In the case of the 10-hour plant, the authors have found that the ratio of accident to production changed as the work progressed during the day, and have concluded that this change was due to the effect of preceding work, or fatigue. We are, then, not concerned simply with the accuracy of the indices, but with the more complex question of whether these indices may be taken as indicative of a physiologic change resulting from the work. We must consider, then, the various factors other than fatigue that could account for variations in the indices. The writer will summarize what appear to him to be important considerations if these factors are to be taken into account, and will use these considerations as a basis for discussion.

1. The hourly output index for a given group of operations must accurately represent the output for the same period of the day and year over which the accident statistics are gathered, and for the same group of operations. Any departure from this must be justified.

2. The hourly accident statistics must either include all the accidents occurring in the group, or an exactly proportionate number of those occurring each hour.

3. In determining the accident risk associated with production one should either deal with the actual hourly output and the actual hourly accidents or, if corrections for lost time are necessary, should demonstrate that these corrections will not produce artificialities in the results.

4. The hourly accident hazard other than that incident on production, that is, the room-hazard or environment-hazard, must be known. If this varies, correction must be made for it. This refers to such things as falling objects, flying chips, etc. Uniformity or variability includes the degree and the duration of exposure.

5. It must be shown that the accidents occurring in the course of the regular work, but over which the worker has no control, bear some constant relation to production. If they do not, corrections must again be made in the index if it is to throw light upon the physiological condition in relation to accidents.

6. It must be shown that the physical environment does not vary from hour to hour in a manner sufficient to affect the hourly accident and output rate. This refers to such conditions as light, temperature, etc.

7. It must be shown that the psycho-physiologic changes or changed reactions, which may affect accident rate or production, or the conditions that may induce these changes, are the effects of the work and not due to other causes.

Do the accident risk indices used in the report satisfy these requirements? As regards the first proposition, the output statistics consist of studies on only a few operations, lasting from two to three weeks at various times during the period of study, whereas the accident statistics, in the case of the 10-hour plant, cover the entire two years, and, at the 8-hour plant, three months.

As regards the time of day, at the 10-hour plant the first hour includes only accidents occurring from 7.00–8.00 A.M. and the last hour only those occurring between 5.00 and 6.00 P.M. At the 8-hour plant, in which the data were gathered from all three shifts, accidents recorded for the first hour are made up of those occurring between 6.00 and 8.00 A.M., 2.00 and 4.00 P.M., and 10.00 and 12.00 P.M., while for the last hour they are made up of accidents occurring between the hours of 2.00 and 4.00 P.M., 10.00 and 12.00 P.M., and 6.00 and 8.00 A.M.

Theoretically, this might affect the accident liability in two ways. First, about 40 per cent. of the workers — those on the afternoon and night shift — would come to work after having spent several hours in outside activity. We should not expect their physiologic condition to be the same as that of the men who went to work on the morning shift after a night of rest. This applies both to the degree of fatigue and to the diurnal physiologic and psychologic changes that may occur. Secondly, there would be a tendency at the 8-hour plant toward neutralizing such diurnal physical conditions as light and temperature. Approximately 90 per cent. of the workers would begin the spell with daylight, while 70 per cent. would end with daylight; 10 per cent. would begin with artificial light, and 30 per cent. end with artificial light. Since the temperature is lower in the early morning and late night, 70 per cent. would begin, and 40 per cent. would end the spell under conditions of lower temperature. (These percentages are based upon the number of men working on each shift, as shown on page 11.) At the 10-hour plant work was always begun in daylight, excepting for a brief time during the winter, and after a night's rest. For six months of the year artificial light was used the last hour, while for the entire year the temperature of the first hour was lower than that of the last hour.

If these conditions do influence working rate and accidents, we should expect a greater variation in both the hourly accident index and the hourly accident risk at the 10-hour than at the 8-hour plant, since at the former these conditions were kept relatively constant for each particular hour of the spell, whereas at the 8-hour plant no diurnal variation was peculiar to any given hour of the spell.

Again, in some groups accident and output statistics were gathered from entirely different types of operations. For example, in the muscular work the output curve is based upon the study of four repetitive jobs — footpress assembly, graduate ring, planish seat, and spin top cap — while the accidents upon which the accident risk is calculated apply entirely to truckers, laborers and utility men, that is, to non-repetitive operations. It is interesting to note that the factory records show that in the two years of study only fourteen accidents occurred to all the workers in three out of four of the jobs forming the muscular group, and that

none of these accidents occurred in the last hour of the day.

As regards the second proposition, we find for the different classes of work that at the 10-hour plant only 9,365 accidents have been analyzed out of a total of nearly 20,000 which occurred. On about 10 per cent. of those tabulated, the information is not adequate for classification according to the hour in which they occurred. The assumption is made that this 10 per cent. was uniformly distributed throughout the day, whereas some fault in accounting methods might have occurred, giving them an entirely different distribution. The statement is made that about 28 per cent. of all the accidents occurred in the class of dexterous handwork, 38 per cent. in muscular work, and 34 per cent. in machine work, whereas in the tables the analysis is based upon 1,455 accidents in dexterous handwork, 3,070 in muscular work, and 4,840 in machine work. In other words, the dexterous handwork includes only 15 per cent. of the total accidents, muscular handwork about 30 per cent., and the machine work about 55 per cent. of the total accidents analyzed. Is it permissible to assume that the unanalyzed 50 per cent. of accidents in the dexterous work would have had the same hourly distribution, and that the discrepancies in the other groups would not have affected also the hourly accident distribution? But this has another aspect, for on page 137 we find the statement: "In order, however, to compare fairly the relation of accidents to activity, the factory must be represented by occupational groups which are fairly proportioned to the actual distribution of accidents." Since the above percentages given by them were based on an analysis of only 230 accidents (see footnote, page 138), is it possible, in view of the above-noted discrepancies, that those conditions have not been met?

With the single exception of the machine operations at the 10-hour plant, all hourly output indices are corrected for lost time. In making these corrections there is the possibility that serious error has occurred because of the two kinds of lost time, since the correction was for the involuntary time only. This can be best presented by a hypothetical case. Suppose that there was an actual output of seventy-five pieces in both the first and ninth hours of the day, an involuntary time loss of fifteen minutes the first hour, and of five minutes the ninth hour of the day, a voluntary time loss of five minutes the first hour, and fifteen minutes the ninth hour, and an accident index of 100.0 the first hour, and 100.0 the ninth hour of the day. According to the methods used in the report, there would be a correction for fifteen minutes lost time the first hour, and five minutes the ninth, giving a corrected output index of 100.0 for the first hour and 82.0 for the ninth hour. Dividing the accident index by the output index for each hour, we should obtain an accident risk index of 100.0 for the first hour, and 122.0 for the ninth hour, although the same number of accidents occurred in each hour, the same number of pieces were produced, and the time required to produce each piece was the same in each hour. The accident risk, therefore, may be artificially raised by the method used in the report, excepting in the fifth, sixth, and tenth hours, for which the amount of lost time is estimated. This would cast serious doubt upon the use made of these hourly risks in comparing the different hours of each shift (page 124).

No study of accidents due to the environment-hazard was made, but the exposure was assumed to be uniform throughout the day. The distribution of this type of accident should be studied before the matter is considered as finally settled. Moreover, the accident-production ratio does not take into account time variation in exposure. At the 10-hour plant considerable lateness occurs (page 79), and at the end of the day considerable time is lost voluntarily as a result of discontinuing work. It is a fact, however, that the workers do not go home, but clean their machines or remain around the factory until the bell rings. The exposure of the worker in the morning is, therefore, reduced by the amount of time that he is late, whereas he is exposed to the factory environment for the full hour at the end of the day. In addition to this, if he cleans his machine during the closing hour, a new type of exposure occurs. Production is, however, the only exposure considered, and this must result in a high risk when production falls, but it might in no way be the result of the length of the working day. This will be further emphasized in discussing the accident risk for the last hour of the night shift, which is one hundred times greater than the average for the other hours. This indicates that there are other risks than production concerned in causing accidents.

In regard to the fifth proposition, unfortunately no analysis is made which will answer this question, although its importance is obvious. A better method would have been to

use only those accidents which were due to some commission or omission on the part of the worker. Likewise, due consideration is not given to the factors concerned in the sixth and seventh propositions.

The above requirements are more nearly fulfilled in the case of the accident hazard for the machine work at the 10-hour plant. Here power consumption is used, which corresponds to actual output. The other objections, however, have not been met. Even if we were to admit that the accident risk determined for the machine work is a valid one, there is nothing with which to compare it at the 8-hour plant, since the accidents were not subdivided according to the various types of work, and no separate hazard for machine work is shown. We are, therefore, led to conclude that the comparison of effect of the length of working day as regards the accident risk is unwarranted on the basis of the material presented.

Discussion of Evidence as Indicative of Relation of Length of Working Day to Indices

The authors have considered the less well maintained output and the greater accident risk at the 10-hour plant to be the result of fatigue due to the greater length of the working day. They have apparently even gone further and considered the output index for the different hours of the day as being a measure of the relative degree of fatigue in the corresponding hours. This assertion is not made in so many words, but is implied in the following statements: ". . . All that makes for waste of power, waste of human energies, such as the records of muscular overfatigue in the operation of ramming molds or the excessive fall of output in the heavy work known as planish seat, shall be condemned on the evidence of the figures" (page 24). Again: "It is notable that even at this plant, where fatigue is least registered in the curve of output. . . ." (page 123). The writer does not wish to imply that fatigue may not be an important factor, but the evidence as presented does not justify the conclusions reached. Even though our measurements, whatever they be, demonstrate fatigue in a given activity, we should not draw further conclusions without obtaining light upon the ultimate effects of the work. Even though hourly output be definitely shown to be a measure of fatigue, it measures acute daily fatigue only. Further studies are required to enable us to say whether or not a given degree of acute daily fatigue is sufficient to constitute a health, economic, or social hazard.

In view of the statement that stereotyping was widely prevalent at the 10-hour plant, it is difficult to see how the output curve can be assumed to be a fatigue curve. It is also stated, it is true, that no stereotyped operations were included in the output curves, but it is doubtful whether this is strictly the case. On pages 84 and 85 is given a list of operations grouped as non-stereotyped, greatly stereotyped, etc. When the quotient obtained by dividing the interquartile range by the median is small, it is apparently taken as an indication of great stereotyping. On the basis of this standard the writer questions the statement that no stereotyped operations are included in the output studies, for this ratio is very low in the case of the retap top cap operation as compared with certain operations listed as greatly stereotyped, yet it is included in the group of muscular operations. Although the hourly output curve does not show the late afternoon rise frequently seen in stereotyped operations, the daily output in the same workers was lower by one hundred pieces in the second period of study, occurring six months later.

Again, it is difficult to see how the output curve of a group or battery of workers can be considered a fatigue curve. In the fuse assembly, the hourly output consists of the number of completely assembled fuses, requiring 100 or more different operations and employing about 300 workers. If it is to be taken as a fatigue index, it must be considered a "group fatigue test." While the writer does not intend to argue that the output is not influenced by fatigue, knowing, as we do, that fatigue may sometimes be followed by an increase in the muscular performance, he feels that output curves, in the present state of our knowledge, can hardly serve as a measure of fatigue.

As regards the accident risk indices as indicative of fatigue, those presented cannot be admitted in the light of the foregoing criticism. But this is not all. From the output indices in the report, and from accident statistics available at the 10-hour plant for the period over which the accident statistics on the day work were gathered, the writer has prepared the hourly accident risk indices for the night work on the machine operations. This is a most useful comparison in considering the question of

whether the high ratio of accidents to production in the tenth hour is due to fatigue, since we have the opportunity of comparing the tenth hour of day work with the tenth hour of night work in the same plant, in which there is a similarity of conditions.

TABLE 1. — ACCIDENT RISK FOR NIGHT WORK, USING PRODUCTION INDICES SHOWN IN TABLE 30, PAGE 148

Working Hours	Percentage Variation from Average Hourly Rate		Actual Number of Accidents	Accident Risk Indices on Basis of Minimum Hourly Ratio (7th hr.)
	Production Indices	Accident Indices		
1	110.9	111.6	152	290.2
2	118.3	175.6	239	428.1
3	120.5	163.1	222	390.7
4	120.6	112.4	153	268.9
5	117.3	113.8	155	279.9
6	102.5	90.4	123	254.5
7	110.2	38.2	52	100.0
8	110.9	88.2	120	229.4
9	108.5	93.2	127	247.8
10	106.2	91.1	124	247.5
11	98.8	81.6	111	238.3
12	74.7	88.9	121	343.3
13	0.49	51.4	70	30,264.9

Table 1 shows the hourly production index, the actual hourly accidents, the hourly accident index, and the accident risk index. In this table the production, the accidents, and the accident risk are all determined in accordance with the method used in the report. However, in the case of night work there was considerable overtime from 6.00 to 9.00 P.M., so that the number of people working between the hours of 6.00 and 9.00 P.M., and consequently the exposure to accidents, was greater than during the remainder of the night. We may then revise our table so that all hours are compared with the fourth hour, and for the sake of ready comparison the same thing may be done with the table covering the day work, that is, Table 18 in the report. This in no way alters the relations of the various hours, but merely changes the magnitude of the various index numbers, for convenience in comparison. (See Table 2.)

The tables show that the accident risk for both the tenth and eleventh hours at night is very low, the eleventh being lower than any hour except two. The risk then rises, and is enormous the thirteenth hour. This appears to be similar to conditions in the day shift, when the risk rises the last two hours, but the last two hours of the day shift correspond to the tenth and eleventh hours of the night work, in which no such rise is seen. (Twenty minutes are lost in the first and the seventh hours.) Certainly it could not be assumed that night work was less fatiguing, although if we were to follow the reasoning used in the report we should have to conclude that there was less fatigue in the eleventh hour of night work than in the ninth hour of day work, since there is a rise of the index in the latter and a drop in the former. Furthermore, the fact that the risk is one hundred times greater for the thirteenth hour suggests that it is not the length of the shift alone in the 10-hour day that is responsible for the greater risk of the last hour, but that there are other factors peculiar to that last hour whether it be the tenth or the thirteenth.

To make the accident risk indices for the night and the day work exactly comparable, power consumption indices should have been used in place of actual output indices. However, comparison of output figures and power consumption in the day shift (pages 60, 70, and 110) indicates that the use of such indices could not change the results sufficiently to affect the above criticism.

The objections raised to the methods of obtaining the accident risk indices and the production indices seem to invalidate their use in comparing the different hours of the day, the different spells, the different types of occupation, and the two plants.

TABLE 2. — COMPARISON OF ACCIDENT RISK FOR NIGHT WORK AND FOR DAY WORK

When Fourth Hour Equals 100.0

Working Hours	Accident Risk Indices for Night Work	Working Hours	Accident Risk Indices for Day Work [1]
1	107.9	1	72.4
2	159.2	2	87.6
3	145.3	3	95.2
4	100.0	4	100.0
5	104.1	5	93.3
6	94.6		
7	37.2	6	78.8
8	85.3	7	98.8
9	92.2	8	100.3
10	92.0	9	105.0
11	88.6	10	116.9
12	127.7		
13	11,254.7		

[1] Derived from Table 18, page 110, of Bulletin 106.

In drawing conclusions based upon the indices used, the authors have assumed that they

could not have been materially affected by any other differences between the two plants than the length of the working day. Although they state (page 20) that "allowance must yet be made for the inevitable differences existing between any two individual establishments," it is not clear that they have made any such allowance. As regards the hourly output indices of the jobs studied, they have not demonstrated that it is the length of the working day rather than the jobs themselves, or other differences, which may account for differences in the output curves in the two plants. The highly standardized product continuing unchanged from year to year at the 8-hour plant, and the conditions resulting therefrom, have not been sufficiently appreciated in this connection. A brief comparison of the two plants may be useful in showing that there are other differences than the length of the working day capable of affecting the hourly output.

The 8-hour plant, as anyone would know from the fact that it is one of the foremost automobile plants, has a highly standardized product, in which the management has had years of experience in setting the production rates and determining the maximum output to be expected of the workers. Under such circumstances, a definite production schedule is established, and there is a highly uniform flow of work from department to department and from operation to operation in order to deliver a definite number of finished cars per day. This has resulted in the setting up of the operations and machines, some of which are automatic, in such relation to each other that by the use of gravity work-slides, roll-ways, endless chain and endless belt power-driven conveyors, the work is kept flowing uniformly from one operation to the next. This results in closer supervision of the workers in maintaining a regular flow of work to avoid "choke" points. In other words, there would tend to be a more uniform hourly stimulus toward production.

At the 10-hour plant with a diverse product, the fuse work was new to the working force, and hundreds of new piece rates on new jobs were set during the period of study. In its regular commercial product, operations sometimes ran continuously for months, but in many other cases the orders were run through on a given job even in less than a day. In addition to this, the period of study was also a period of increased growth, doubling the number of people employed, whereas at the 8-hour plant a much longer experience on the part of the worker was the rule. Recognizing the fact that the jobs were frequently changed, that time was required for learning, and that production could not be so carefully scheduled, the rates were set at the 10-hour plant with considerable time allowance for changes, repairs, and pauses of the workers on their own account. At the 8-hour plant, on the other hand, foremen made hourly output studies of the individual workers on their own account. While we do not know to what extent these differences affected the hourly output curves, one might expect in either an 8-hour day or a 10-hour day a more uniform hourly output in a plant making a highly standardized product. We should certainly know the extent to which the output curves were affected by these important differences before ascribing as a cause the length of the working day.

Unfortunately direct evidence was not obtained in regard to the effect of inexperience at the 10-hour plant upon the hourly output or upon accidents. Possibly the accidents in the year 1915 may be significant in this connection, since this is the year in which the first great additions of new working force began. In the year 1917 the accidents of the tenth hour were 125 per cent. of those occurring in the first hour, in 1916 about 95 per cent., but in 1915 only 50 per cent. This better showing of the tenth hour in 1915 should be explained before drawing conclusions regarding the cause of the higher accident risk of the last hour.

Before leaving the question of the interpretation of these indices the writer would like to add an observation which is not alone interesting in connection with the accident risk in the different hours of the day, but which further serves to indicate the complexity of the subject. The point in question is the relative speed in working the different hours of the day. This can be determined by taking into account the actual number of pieces of product finished during various hours of the day and the actual working time obtained by subtracting from the hour the total voluntary and involuntary time lost. For two of the machine operations shown in the report these calculations have been made. Table 3 shows the average number of seconds required for the various hours of the day. In both of these operations the time required for each piece in the last hour is much shorter than that required in the first hour, with which all others are compared in computing accident

risk, and the average time in the last hour is below the average time of all the hours of the day. This is significant because speed has been shown to be an important factor in accident risk, and it exemplifies the necessity of taking other conditions into account.

TABLE 3. — AVERAGE TIME REQUIRED FOR MACHINE OPERATIONS EACH WORKING HOUR

Operation	Average Time in Seconds Required Each Working Hour									
	1	2	3	4	5	6	7	8	9	10
Face and score train ring	11.3	9.5	9.8	7.9	7.8	9.9	8.9	9.9	8.0	8.2
Spin top cap	24.1	18.5	17.3	14.8	15.2	18.0	17.6	16.9	16.2	15.3

Criticism of Indices Used as Measures of Efficiency

Even if the hourly output indices were admitted as representative of each factory as a whole, their use as a basis of comparison of the efficiency of two different factories must still be justified. It must be borne in mind that these indices are entirely relative, and in no way indicate which factory was the more efficient in its own maximum hour. A factory might have an output in which the index was 100.0 for each hour of the day, and yet be working at only 50 per cent. of its possible maximum.

On the basis of a study of less than a half dozen jobs, it is stated that there was a greater amount of lost time at the 10-hour plant. But in order for this to establish proof of the greater efficiency of the 8-hour plant as regards output, it should be shown that the lost time at the 10-hour plant was sufficient to have actually reduced the length of working period to, or approximately to, eight hours. The mere statement of the hourly output indices does not enable one to form a clear idea of the amount of time lost through slowed working and voluntary pauses, which is stated as the cause of the less well maintained output curve at the 10-hour plant. Since these pauses are important only as they affect output, and since the hour of maximum production in the two plants is considered on a par, it is possible to determine the total amount of time lost in this way with the same degree of accuracy with which the output indices are determined. Using the output indices given on page 74, we have calculated the amount of time lost hourly at each plant as shown in Table 4. Therefore, slowed production and voluntary pauses amount to 43.2 minutes at the 10-hour plant and 16.7 minutes at the 8-hour plant.

It is obvious from this that the 10-hour plant cannot reduce its day to eight hours and maintain the same production unless the production of the maximum hour is increased. The hourly output indices obviously must have a very limited use as a comparative measure unless we can obtain information which will enable us to evaluate the maximum hour.

There is both a human and an economic question regarding the relation of accidents to efficiency. When there is an actual decrease in the number of accidents occurring in the last hours of the day, the writer is inclined to question whether we are not going too far in attaching a great deal of importance to the ratio of accidents to production. Considering the ques-

TABLE 4. — LOST TIME AT THE TWO FACTORIES ABOVE THAT LOST IN HOUR OF MAXIMUM PRODUCTION BASED ON PRODUCTION INDICES SHOWN IN REPORT

Working Hours	Average Production Index	Minutes Worked When Maximum Hour Is Given Value of 60 Minutes	Minutes of Lost Time by Which Each Hour Exceeds Maximum Hour
		8-Hour Plant	
1	89.6	55.2	4.8
2	96.4	59.4	0.6
3	97.4	60.0	0.0
4	94.4	58.2	1.8
5	95.7	59.0	1.0
6	94.4	58.2	1.8
7	94.2	58.0	2.0
8	89.8	55.3	4.7
			Total 16.7
		10-Hour Plant	
1	82.7	51.0	9.0
2	93.8	57.9	2.1
3	95.6	59.0	1.0
4	97.2	60.0	0.0
5	90.4	55.8	4.2
6	90.1	55.6	4.4
7	91.6	56.5	3.5
8	91.1	56.2	3.8
9	90.7	56.0	4.0
10	79.1	48.8	11.2
			Total 43.2

tion from the human standpoint, the worker is exposed to a certain number of accidents in the factory in which he is employed. The chief question which concerns him is whether it is more dangerous for him in the factory in the ninth and tenth hours than in the other hours of the day. In other words, the number of accidents per man per working hour is the worker's chief consideration rather than the number of accidents per unit of production. The figures in Table 22 of the report show that from his standpoint only the first, fifth, and sixth hours are preferable to the tenth hour.

From the purely economic standpoint the question of ratio of accidents to production may merit consideration. We might ask what is the cost of accidents in the various hours of the day per $100.00 of product. Using the production indices and the accident indices shown in the report, and the data on compensation for accidents available from other sources, the writer has calculated this cost. It is found to be approximately 3.7 cents greater in the tenth hour than in the fourth hour, which is an hour of relatively high production — a cost hardly sufficient to be of importance. It is not the wish of the author to be understood as attempting to place a dollars-and-cents value upon human injury. It is difficult to express the seriousness of an accident so that it may be used for statistical purposes, but the lost time is one of the indices of the seriousness of an accident, and compensation for it is certainly a manufacturing cost. This calculation is interesting in connection with the question of accidents and efficiency.

The report indicates neither the relative seriousness of the accidents at the two plants nor the relative number of accidents per worker, the assumption being made that it is only of importance to determine the hourly ratio to production. It does not, however, seem to be entirely irrelevant to compare the accident frequency per hour at the two plants. From the figures given in the report in Tables 21 and 22, we may calculate the number of accidents per man per unit of time at the two plants. A simple calculation will reveal the fact that the accident risk for the 10-hour plant, as compared with that of the 8-hour plant, is as 1:1.40; in other words, the actual danger to the worker from accidents per hour is greater at the 8-hour plant. The ratio per man per working day at the 10-hour plant, as compared with the 8-hour plant, is as 1 : 1.12. There is no evidence to indicate whether or not this difference is due to the method of working, the length of day, or mechanical conditions, but it has not been proved to be irrelevant.

In concluding, it may be said that in view of the objections to the output and accident indices, neither can be accepted as valid either for the plant as a whole or for a sufficient part of either plant to be truly representative. The evidence on lost time is not conclusive, nor is that on stereotyping, which at best was used only as corroborative evidence. Moreover, even if we were to grant the validity of the use of the output and accident indices in estimating the efficiency of various hours in the same plant, we could not draw conclusions in regard to the relative efficiency of the two plants, since the maximum hour is not evaluated. A measure of output comparing only the relative hours of the day would not go far in helping to solve the workday from the standpoint of wartime needs, which were, to quote from the introduction of the report, "to attain maximum production without prejudice to national vigor." The greatest hourly efficiency, the standard used in the report, might possibly be attained on a 4-hour day, but with even a lesser hourly efficiency we undoubtedly would attain a greater daily, monthly, or yearly efficiency on a workday of greater length, if we define efficiency as the greatest production with the least cost compatible with reasonable health, social, and cultural standards. The standards of efficiency employed — namely, maintenance of output, lost time, and accident risk — may be of value in the study of the most efficient working day when based upon a better occupational classification, when sufficient data and controlled data are gathered, and when measurements according to these standards are correlated with other measures, such as percentage of accident and illness incidence in the succeeding months or years of employment, comparative functional studies of organs and tissues, comparative studies of total daily, weekly, and monthly output, spoiled work, labor turnover and transfers, studies of behavior reactions, the quality of the workers attracted by the workday of different length, etc. Factors other than the length of the working day must be ruled out, and this may be accomplished by the study of different shifts in the same plant working a different number of hours, or by the study of a greater number of plants.

Space does not remain nor does the writer feel that it is necessary to point out the obvious advances which have been made in the present study, and the valuable influence which it must have on future work. The attempt to compare two different plants on the basis of representative hourly output and accident risk curves, derived from studies resting upon a common job classification, constitutes a bold stroke in a new direction, and should stimulate further research. Among other things, it exemplifies strikingly the necessity of a physiological analysis of industrial occupations.

It is unfortunate that the limitations of the material were not more carefully pointed out, since the problem is obviously still in the experimental stage, and that such sweeping conclusions were reached as those on page 26, even though it might have been necessary to sacrifice some of the interest of the general reader.

A REPLY TO DISCUSSION OF PUBLIC HEALTH BULLETIN NO. 106, COMPARISON OF AN EIGHT-HOUR PLANT AND A TEN-HOUR PLANT

P. SARGANT FLORENCE, Ph.D.

Associate Sanitarian, U. S. Public Health Service (Reserve)

Dr. Ryan's interesting discussion of Public Health Bulletin No. 106 deals almost entirely with the statistical treatment of the material collected. As the officer chiefly responsible for this phase of the investigation, I am very glad to avail myself of the opportunity to reply to his criticisms. Dr. Ryan makes so many diverse points that it is difficult to know where to begin. As space is somewhat limited, however, I shall adopt the plan of indicating certain general errors in thought to which the majority of Dr. Ryan's points can be attributed, such independent points as remain being then considered individually.

Anyone, however scientifically trained, who has not had the experience of sifting multitudinous data in such a way as to answer specific problems, is likely to theorize at the expense of one or two practical rules that have to be observed under the given circumstances. These rules may be briefly formulated as follows: The exact problems to be solved must be constantly kept in view in relation to the means for solving them; and a sense of perspective should be exercised to keep the right proportion between factors found to be of primary import to the solution of the problem, as against factors of secondary or tertiary import.

In his criticism, Dr. Ryan seems to lack this sense of proportion. He does not keep in mind the specific problem on which conclusions were drawn; he is almost exclusively exercised over points of secondary if not of tertiary importance to the problem; and he forgets that, desirable as it may be to analyze and evaluate the effect of all possible factors however improbable their connection with the issue, this is not practically feasible under present conditions of industrial and scientific organization.

We may, therefore, bring the majority of Dr. Ryan's points of criticism under the following heads: (*a*) criticisms due to a misunderstanding of the exact problem as to which conclusions were drawn; (*b*) criticisms that fail to distinguish the first-rate from the second-rate and third-rate considerations involved in the problem; (*c*) criticisms which, in evaluating these subsidiary considerations, insist on an idealistic perfection wholly impracticable in the present state of our knowledge and opportunities for knowledge. The few independent points that remain for consideration will then be found to consist in (*d*) criticisms of the hourly curves of accident risk per unit of production which were presented in the Bulletin.

Misunderstanding of Problems Involved. — The main problems to which the investigation under discussion attempted to find an answer — and the answers as far as they could be ascertained are given in the conclusions of the Bulletin — were briefly as follows:

1. To find the relations between consecutive hours of the working day for various operations within the same plant in the matter of output, accidents, and other indices of human working capacity.

2. To contrast the relations found within each plant as between the two plants; the actual showing of each plant being first compared with its *own* best showing. This is not a direct but an indirect comparison of the records of output, accident, etc., of each plant.

Dr. Ryan's great mistake — one which involves one-third of his entire discussion — is in supposing that it was the object of the Bulletin to form a complete picture of each plant in isolation and for its own sake. There is nothing printed in the conclusions on page 26 (which Dr. Ryan apparently takes as his center of attack) to warrant this belief and the deliberate procedure of the authors as explained in the Bulletin definitely contradicts such a notion.

If the authors of the Bulletin aimed to give an all-comprising, duly proportioned picture of each plant, why did they deliberately falsify this picture for the 10-hour plant by combining the output curves for the different types of work at this plant, not in proportion as these types were found to occur at the 10-hour plant itself, but on the contrary as they were found to occur at the 8-hour plant? While Dr. Ryan is busily engaged in criticizing some small points that prevent a true picture being drawn of the output at the 10-hour plant as a whole, he apparently omits to see this enormous error which the authors deliberately committed.

The fact is that Dr. Ryan is here following the wrong trail. An output curve was built up to comprise all the operations studied in each plant in certain definite proportions, for the purpose of comparing the two plants *in respect to the same types of work*. It was definitely recognized by the authors of the Bulletin that if the length of hours factor was to be considered in its relation to output, many other factors affecting the shape of the output curve must first be equalized as between the two plants. Previous work, particularly that of the British Association Committee on Fatigue, had shown that the type of work had an enormous influence on the shape of the curve. Consequently, the type of work was considered a primary factor, and the greatest care was taken to eliminate its effect as well as that of all other primary factors such as inexperience, deliberate restriction of output, lack of incentive, stoppages enforced on the workers by machine breakdowns, and so on. The method and reason for eliminating the disturbing effect of the type of work factor is clearly given in the Bulletin itself (pages 74 and 75).

"For a fair comparison of working capacity and production at the two plants it is obviously necessary to compare the output of processes and types as nearly alike as possible at each factory in order to exclude all differences except the point at issue, and that is, the difference in the length of the workday. Obviously again, in a general metal-working establishment such as the 10-hour plant, there are many processes and operations not included in the representative output of the automobile factory. We must, therefore, for our present purpose take figures representing not the total activity of the factory but the average of the four types of work studied at the eight-hour plant."

The authors were mainly concerned, then, in obtaining output curves from similar types of work in each of the plants studied and in giving each type equal weight, not primarily in "representing the total activity of the factory." The text of the Bulletin is absolutely definite on this point.

The main attack in Dr. Ryan's entire criticism of classification of occupations and of representation in classes seems to me, then, directed against the proverbial man of straw which he himself has erected, and we must contradict his statement that the classification of occupations "is not shown to be adequate for the use to which it has been put." To prove it inadequate, Dr. Ryan would have to show that the method of classification and the operations within each class are different in the two plants. All he does show is that in the case of both plants the classification is a rough one — a point fully admitted in the Bulletin — and that within each class non-repeated jobs are necessarily excluded — a point also admitted.

No doubt, Dr. Ryan was misled by the term "representative" used in connection with these composite curves; but after all, when we send representatives to Congress they represent us only for some purposes and not for others, and similarly these output curves must be considered in relation to the specific purposes to which they are put, and not as representative for all purposes.

There is one other error into which Dr. Ryan has fallen as a result of a misunderstanding of the problems on which conclusions were drawn. It is nowhere maintained in the Bulletin that the total gross production of the 8-hour plant was greater than that of the 10-hour plant, or that the total gross production of the 10-hour plant would be increased by a reduction to an 8-hour schedule. The authors were fully aware that the data for formulating such a conclusion were not in their possession. Efficiency, which is the word used in the Bulletin, means a good deal more than mere production. As agreed upon by a long line of economists and supported by the conceptions of scientific management, efficiency is considered as a relation between production and costs,* and it is unquestionable that, other things being equal, the heavier the hourly variation in output throughout the shift, and the greater the lost time, accidents, and restriction of output, the less the relative efficiency. This being the case, Dr. Ryan's table showing that lost time, though two and a half times greater at the 10-hour plant, is not great enough to make the total gross production of the 10-hour plant less than that of the 8-hour plant, is beside the point, and introduces as well a rather confusing notion of lost time.

Lack of Discrimination of Relative Importance of Factors. — The mere fact of misunderstand-

* Costs may be taken as including the costs in money to the employer only, or the costs (often not measurable in money) to the community at large. If costs be taken in this latter sense, efficiency may be summed up justly as "maximum production without prejudice to national vigor," and we fail to see Dr. Ryan's implication of a contradiction between the phrase in the introduction of the Bulletin and the use of the word efficiency in the conclusions.

ing the problems involved would in itself, of course, lead to a faulty evaluation of the relative importance of the various factors. Thus, Dr. Ryan devotes considerable space to the discussion of the methods of classifying occupations and of the proper representation within the classes — factors of distinctly secondary importance in comparison with the question of adopting the same classification and representation for both plants.

Such instances have, however, already been mentioned under the discussion of the misunderstanding of the problems involved and may be passed over for the present. I wish to show here that even where the problem at issue is grasped, Dr. Ryan has failed to see the relative importance of the several factors, and, indeed, once or twice in his own calculations has overlooked factors of obviously prime importance. Thus, Dr. Ryan calculates that "the actual danger to the worker from accidents" per working day is greater (by 12 per cent.) at the 8-hour plant than at the 10-hour plant. Aside from the possibility of deriving this figure from the information given in the Bulletin, Dr. Ryan has here overlooked a factor of cardinal importance. He has not considered whether the tradition of what constitutes an accident may not be very different in the two plants, nor has he considered the possibility that the 8-hour plant with six widely distributed first-aid stations may have recorded more of the less serious accidents which occurred than did the 10-hour plant with but one first-aid station (two at the end of the period studied). In fact, to compare *directly* the accident frequency of the two isolated plants is, from a scientific standpoint, extremely indiscreet.

Again, in criticizing secondary points, Dr. Ryan entirely omits to watch considerations of primary importance when he questions the representative character of the sample of accidents taken at the 10-hour plant. Two questions are here involved: (1) the reliability of the sample as to the distribution of accidents over the hours of the day; (2) the reliability of the sample as to the types of occupations comprised.

In the Bulletin we made an assumption about point (1), while Dr. Ryan in his discussion makes an assumption about point (2). I venture to think that while our assumption neglects at most only a tertiary consideration (that is, a bookkeeping omission as to the hour of occurrence in 10 per cent. of the cases — an omission as likely to occur in one hour as another), Dr. Ryan's assumption neglects a primary consideration applying to a majority of the cases. He assumes that 20,000 accidents are distributed as to the type of work in the same proportion as the 9,365 accidents analyzed by us. As a matter of fact, the main reason for rejecting in this analysis over half the accidents was the disorderly way in which certain of the occupations of the injured employees were listed at the factory office. For instance, some clerks, when in doubt, invariably put down "laborer" as the occupation of a male employee, and so on. The investigators were, therefore, forced to pick only accidents occurring in those occupation classes that were found free from this "dumping" process, and there happened to be more of such occupations free from doubt in the machine type of work than in the muscular and dexterous types. What Dr. Ryan notes as discrepancies in the Bulletin are, therefore, in this instance the result of a false assumption on his part as to the relative accuracy in reporting accidents in different classes of occupations. On the other hand, the 230 accidents taken at random, which the investigators analyzed in detail, would, I think, constitute in the opinion of most statisticians a reliable sample, at any rate for purposes of division into but three fairly equally populated types.

In the instances just given, it is evident which are the primary and which the subsidiary factors. It may be answered, however, that in a great number of cases the exact importance of any given factor cannot well be known offhand. This is perfectly true and Dr. Ryan probably does not realize the amount of preliminary statistical work that was undertaken to determine this very question of relative importance. He brings forward in particular some considerations as of primary importance which, after a preliminary investigation, we assigned to second or third place as far as the operations selected for study were concerned. These considerations are as follows:

1. That the accident-output ratio is unduly affected by the variations in the amounts of corrected and uncorrected lost time as between different hours. The authors admit in the Bulletin that actual output would be preferable to corrected output for use as the base of the accident-output ratio. "In order, however, to avoid introducing a different though closely resembling set of curves" (page 105) they decided to hold to the corrected curves used in the

earlier chapters. This decision was made after it had been found that the error involved was not great, and that in so far as there was an error, it would tend to understate the accident risk. In fact, the corrections seriously affecting the output curves occurred only in the hours of starting and stopping work at the 10-hour plant — *i. e.*, the first, fifth, sixth and tenth — and due allowance (as Dr. Ryan agrees) was made in these cases. Such a large correction as Dr. Ryan supposes to occur in the ninth hour of an average output curve, actually, it was found, never does occur, and Dr. Ryan seems here to raise a hypothetical difficulty of small practical importance.

2. That there were more women employed at the 10-hour plant, and that relatively women are over-represented in the operations selected there. The latter point is questionable. At the 10-hour plant investigation showed that 25 per cent. of the employees were women, and that 68 per cent. of the operations studied engaged women. At the 8-hour plant 1 per cent. of the employees were women and 13 per cent. of the operations studied engaged women (three out of twenty-three). In short, women were over-represented at both plants, chiefly because a larger proportion of women are usually engaged in repetitive jobs.

As to the effect of sex on the output curve, the evidence was found to be negative. If within the same plant and the same type of operation the curve for men be compared with the curve for women, neither appears to be maintained any better than the other.

3. That relatively unskilled workers were selected in the 10-hour plant. I have no means of checking the figures which Dr. Ryan gives as representing the average wage throughout the plant, though from the investigation which we made at the time these figures seem to me considerably too high. Possibly they do not refer to the beginning of 1918 when our output observations took place, and may include also the special bonus. However this may be, there is no question that repetitive jobs call for a relatively low grade of skill. But this again applies to both plants.

4. We may here group together a number of points raising the whole question of the comparability of the two plants as to industrial and technical organization. Dr. Ryan maintains that even the indirect comparison which we attempted is valueless because: (*a*) in spite of our careful exclusion of operations in the 10-hour plant where output was found restricted, some restriction is evidenced in a few of the operations remaining; (*b*) the 10-hour plant often worked on short orders while the 8-hour plant had a uniform product; (*c*) the 8-hour plant was more standardized and in particular employed more conveyors and automatic machines, while its "foremen made hourly output studies of the individual workers on their own account." In contrast with these devices, "the rates were set at the 10-hour plant with considerable time allowances."

(*a*) Dr. Ryan is not fully informed as to the methods used in detecting restriction of output. The narrowness of the deviation between the output of individuals was not by any means the sole test of restriction. In a special study the investigators plotted the frequency curves of the daily output of individuals in various operations, and set aside as restricted those which showed a negative "skew." The method is discussed in a recent article by the writer in the *Journal of the American Statistical Society*, September, 1920, and there is no need to enter more fully into the matter here.

(*b*) At the 10-hour plant, as a matter of fact, the investigators particularly avoided studying short orders. Besides the long period required for observation, a rule was made that only those workers should be observed who had already been a long time on the job, and before selecting an operation for study it was always ascertained whether that operation was to be continued over a considerable period of time. The operations selected in the 10-hour plant do not, therefore, show a great contrast with those of the 8-hour plant; some of them, indeed, were running before the 8-hour plant was even founded.

(*c*) In the operations actually selected at the 8-hour plant at least eighteen out of the twenty-three listed had no conveyors connected with them,* and no automatic machines whatever were studied. As to the foremen's records, the investigators collected samples of these whereever they were kept (in seven departments out of the sixty-eight), and found them to have very little importance in practice. The figures given seem to have been based largely on the

* Excess of stoppages for lack of materials, which might have been caused at the 10-hour plant by relative absence of conveyors, would be allowed for by the "correction" of the output. As a matter of fact, conveyors were used for a large number of jobs also in the 10-hour plant, and one or two of these jobs were studied for the Bulletin.

foremen's idea of what would most please the management.

Concerning the piece rates set, there is no question that at the 10-hour plant workers were not able to earn as much pay per day as at the 8-hour plant, however many allowances may have been made. Human needs in food, clothing, shelter, etc., being much the same whether the employee works eight or ten hours, it follows that the "economic" stimulus to produce must have been distinctly greater at the 10-hour plant than at the 8-hour plant where a "comfort" wage was paid on a purely time basis.

Insistence on Impractical Perfection in Evaluating Subsidiary Factors. — Even in the case of factors found to be of secondary or tertiary importance it would undoubtedly be desirable to be able to evaluate their importance quite exactly, and in the further progress of the science this refinement will, no doubt, be achieved. But it is surely expecting a little too much of an investigation limited in time and funds that its methods should have leaped to perfection in the minutest details. Though recognizing the facts in his concluding paragraphs, Dr. Ryan here fails to keep in mind the rudimentary basis on which the investigators had to build and the real progress in technic which they succeeded in achieving.*

Dr. Ryan tells us that two means of investigating non-repetitive operations are available: one, the effects of the work on the physiological function or state; and the other, the energy expenditure or oxygen consumption throughout the day. In a fairly exhaustive acquaintance with the literature of industrial fatigue I fail to recall any application in industry of the latter test, and, in truth, the whole series of psychological and physiological tests of fatigue seem to have fallen on evil days. We find Dr. Stanley Kent in his second report on *An Investigation of Industrial Fatigue by Physiological Methods* turning to pure output studies, and we read of the abandonment by the present British Industrial Fatigue Research Board of the search for psychological tests. Facts such as these are not necessarily conclusive for the future conduct of fatigue investigations, but they certainly are conclusive as to the inadvisability of using these tests in Bulletin No. 106.

Again, as a basis for job classification, Dr. Ryan demands a classification which shall "take into account both quantitatively and qualitatively the afferent stimuli, the motor response, and the secondary associations in the central and sympathetic nervous systems." No one is in greater agreement with this general plan than I. In fact, I have consistently advocated it for the last five years, and have come to the same conclusion as Dr. Ryan — namely, "that it will be workable only after prolonged study." And this is the precise point.

The method of job classification which the authors of the Bulletin used has since been fully presented by the writer.† The following reasons made it seem adequate for the purposes of the Bulletin:

1. The same method, as stated above, was used in both plants.

2. The basis of classification was thoroughly objective, and the inclusion or exclusion of a given job from any class was not determined by personal bias on the part of observers.

3. It marked the first step in a physiological classification. Work with and without machines makes distinctly different requirements of the human organism, and the division within the no-machine group was based on the part of the body engaged. It was recognized that there were few operations in this group where the worker did not *handle* his material, but dexterous work was defined to exclude operations like footpress assembly, where body or feet were used as well. Within machine work, lathe work covers only those cases where the man "operates" the machine in the strict sense of the word, while miscellaneous work covers those cases where the man's work is to steer, tend, feed, or stock the power-driven machine. Most of these sub-types, it should be said, were represented in both plants.

4. The classification bore some relation to the actual classification that we found in use for practical factory purposes and thus the inclusion of all the jobs within a given factory was made easier.

5. There are certain remarkable agreements in the shape of the curves between the same type in the different plants, but quite distinct characteristics as between different types in the same plant.

6. When comparing the different classes of occupations thus formed with the number of employees they engage, each class was found to account roughly for an equal portion of the

* In the matter of accidents as an index of fatigue, this development in technic is sketched in the Bulletin itself.

† See last chapter in Muscio's *Lectures in Industrial Administration*, Isaac Pitman and Sons, London.

factory working force. This enabled equal weight to be attached to each type.

It should be said that the scheme of classification which we adopted was not based on any one of the six reasons advanced above as Dr. Ryan seems to think, but rather on a joint consideration of them all. The exact method of classification was, for the purpose of the investigation, a secondary consideration provided the same classification was adopted at both plants and the same weight given to each type of work. But in spite of the relative unimportance of the matter, I would maintain that the Bulletin puts forward a very practical and useful scheme for classifying industrial occupations, and with this as a basis has brought together output studies from more diverse types of industrial operations than have appeared together before.

Criticism of Curves of Accident Risk per Unit of Production. — There remain a number of points of criticism concerned with one section of the investigation — namely, the hourly accident-output curve. The Bulletin presented curves of this nature for the two plants as a whole and for the muscular, dexterous, and machine work types of occupation in the 10-hour plant. By this means an attempt was made to find the risk of accident per unit of production, and to meet the objections of Dr. Vernon and others to the use of an absolute accident curve as a measure of fatigue. The history of this whole controversy, which largely determined the methods that we adopted, is given in the Bulletin (pages 95–100).*

Dr. Ryan brings forward a counter-objection that there are factory environment hazards varying throughout the day as well as production hazards, and apparently urges a return to the absolute accident curve. He also points out that our accident curves do not refer to quite the same group of workers as do our production curves.

Here it is admittedly important to obtain a production curve thoroughly representative of all the operations which the accident curve covers, and the investigators did their utmost in this connection to improve upon previous work. For the 10-hour plant the compounding of an output curve out of three distinct type-of-work curves was based on a searching occupation census taken at the plant, and the power consumption curve, instead of sample output curves, was used to represent machine work. Admittedly, for reasons given in a footnote (page 138) it was difficult to obtain a full sampling of muscular work, though dexterous work, being largely repetitive, was probably fairly sampled.

In spite of the imperfections admitted in the Bulletin itself, the results seem to us significant for two reasons. Even if the accident-output ratio curves be set aside and a return made to the absolute accident curves, the difference in result is one of degree rather than of kind. These absolute accident curves are given in the tables and the diagrams of the Bulletin just as fully as the ratio curves, and anyone unable to accept the prevailing opinion among investigators as to the advantages of the ratio curve may satisfy himself by reference to the original data.

Secondly, the differences noted between the curves of the two plants and between the three types of work in one of the plants are so remarkable and so consistent that it would require considerations much more serious than Dr. Ryan has brought forward to upset our conclusions. The best founded of Dr. Ryan's contentions is that objecting to the merging of the three shifts at the 8-hour plant. Undoubtedly this had the effect of smoothing the 8-hour curve to a certain extent, though not nearly enough to wipe out the very marked difference between the 8-hour and 10-hour curves which we presented. Since four out of five of our conclusions (page 26) in this matter of accidents refer to the relation of consecutive hours of work in the same plant regardless of shift, and since the limited extent of this smoothing was duly ascertained, it was not thought worth while to present the shifts at the 8-hour plant separately. Such a separate presentation would involve the use of somewhat confusing shift production curves as well as shift accident curves.

In regard to the night-work curve of accident-output ratios which Dr. Ryan tabulates, this seems to me of distinctly inferior calibre to the curves presented in the Bulletin. The power consumption is not used to represent machine work production, but five isolated output curves not necessarily good samples of machine

* Dr. Ryan seems occasionally to fall into the error of supposing that the use of the accident-output ratio as a measure of fatigue necessarily involves the theory that both accidents (directly) and output (inversely) measure fatigue. This is not the case, but we have not the space here to repeat the argument fully presented in the Bulletin itself.

work in general, and the index numbers are by no means formed "in accordance with the methods used in the report," as Dr. Ryan states. Apart from technical points, it is questionable how far one can argue from a comparison of the tenth* hour of a 12-hour shift with the ninth hour of a 10-hour shift. Fatigue in the sense used in the Bulletin to include "its remoter manifestations of a psychological nature," is not a mere matter of the hours already passed, but is also likely to be modified by the thought of the continuous hours of work that are coming. The investigators based no argument on the comparison of the seventh hourly ratio at the 10-hour plant with the eighth hourly ratio at the 8-hour plant (however unfavorable to the former), and there is no valid reason for introducing this sort of test as between day and night work. As for factors peculiar to the last hour, it should be noted that the last hour at the 8-hour plant showed no extraordinary rise in the accident ratio; on the contrary, it showed a heavy fall.

* Owing to the twenty-minute recesses at 6 and 12 o'clock, what Dr. Ryan calls the eleventh is more strictly the tenth working hour.

Summary

In important particulars, Dr. Ryan's criticism mistakes the trend of the argument. He emphasizes relatively unimportant factors in his discussion, and in their evaluation insists on ideal perfection. It is doubtful whether the refinements which Dr. Ryan suggests would have made any material difference in the conclusions to be drawn from a comparison of the 8-hour and 10-hour systems as in operation in the two plants studied.

The authors of the Bulletin did not underrate the need for a complete examination of all possible points in question. But such complete perfection, it should be remembered, is impossible without (1) much greater willingness on the part of employers to experiment with different lengths of working periods under scientific control, and (2) a great advance in the theory of industrial physiology.

BOOK REVIEWS

The Industrial Clinic: A Handbook Dealing with Health in Work. Edited by Edgar L. Collis, M.D. Oxon., M.R.C.P., Talbot Professor of Preventive Medicine in the University of Wales; Late Director of Welfare and Health, Ministry of Munitions, and H. M. Medical Inspector of Factories. Cloth. Pp. 239 with illustrations, appendix, and index. London: John Bale, Sons & Danielsson, Ltd., 1920.

In this small book, Dr. Collis has brought together excellent discussions of many phases of industrial medical practice. There are briefly but comprehensively presented the problems of the medical examination of the worker, the selection and placement of the worker, the relations of industrial efficiency and fatigue, the hygiene of working conditions, of the individual, of food values in relation to occupation, of canteen service and of first-aid administration.

Although the several contributors have based their observations for the most part upon British experience, there is sufficient similarity between industrial conditions in the United States and in Great Britain for many of the authors' recommendations to be readily applicable.

The book should be of value to industrial and mercantile physicians and nurses as well as to executives of industrial establishments. — *Wade Wright.*

ANNUAL CONFERENCE OF THE MASSACHUSETTS SOCIETY FOR MENTAL HYGIENE

The Human Element in Industry will be the general subject of the coming Annual Conference of the Massachusetts Society for Mental Hygiene, which is to be held in Ford Hall, Boston, Mass., on Thursday evening, April 7, 1921, at 8 o'clock.

Dr. Wade Wright, Secretary of the Division of Industrial Hygiene, Harvard Medical School, will speak on *Industrial Hygiene;* Dr. C. Macfie Campbell, Director of the Boston Psychopathic Hospital, will discuss the *Mental Health of the Industrial Worker;* and Mr. Boyd Fisher will present the *Personnel Problem in Industry.*

The public is cordially invited.

SUBJECT INDEX TO VOLUME II

This is a subject index to all the reading matter in the JOURNAL OF INDUSTRIAL HYGIENE and one should, therefore, look for the subject word, with the following exception: "Book Notices" are indexed under this title on page 489. The name of the author follows the subject eutry in parentheses.

For author index see page 490.

BOOK NOTICES

AUTHOR INDEX TO VOLUME II

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

SUPPLEMENTARY TO

THE JOURNAL OF INDUSTRIAL HYGIENE

EDITORS

DAVID L. EDSALL, M.D., S.D., United States

A. F. STANLEY KENT, A.M., D.Sc., Great Britain

VOLUME II

MAY, 1920–APRIL, 1921

PUBLISHERS

HARVARD UNIVERSITY PRESS

1 Divinity Avenue, Cambridge, Mass.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II — MAY, 1920 — NUMBER 1

CONTENTS

GENERAL

DEFECTS FOUND IN DRAFTED MEN, II. *C. B. Davenport* and *A. G. Love*. Scientific Monthly, Feb., 1920, 10, No. 2, 125–141. — This article is the second installment of an analytical study of the statistics of the medical examinations of drafted men. There are fourteen maps showing the distribution throughout the country of diseases of the eye, heart, varicose veins, tonsillitis, asthma, epilepsy, mental diseases, mental deficiency, and defects of the teeth. The distribution of total defects and diseases in the states is also exhibited. There appear to be two great centers of defect, one in the northeastern part of the United States, and the other including especially the states on the Pacific Coast and the two mountain states, Wyoming and Colorado. Rhode Island has the highest defect rate of all the states, flatfoot and hernia being especially frequent. Here also many minor defects reach nearly the maximum ratio. The authors explain this as due to the defectiveness or non-resistance of the stock which has been drawn to the state for manufacturing pursuits. The defects are not to be ascribed to the occupation itself, but to the fact that the occupation, being relatively low-grade and ill-paid, has attracted a stock with inherent defects or susceptibility to disease. Next to Rhode Island comes Vermont, probably on account of the presence of a large number of French Canadians, in whom the defect rate is particularly high. The third state is Virginia, suffering

from its age and its consanguineous matings, and in part from the nature of its colored population. At the bottom of the list is Kansas, with only about half the defect rate of Rhode Island. South Dakota, Nebraska, Kentucky, and Arkansas (prevailingly white agricultural states) also stand low.

The data have been computed also with reference to racial and to occupational distribution. Clerical work produces myopia; standing in shops and walking on pavements in tight shoes accounts for many of the bad feet of city people. The eastern manufacturing group is characterized by an excess of myopia, valvular diseases of the heart, speech defect, bad teeth, and underweight. The group containing a large proportion of mining population is characterized by a high rate of venereal diseases and by much tonsillitis. The point is emphasized that the figures do not indicate merely the effect of conditions upon physique, but are largely controlled by the constitution of the populations which have selected different regions for homes and the different occupations prevailing in the regions. Comparing rural and urban districts, the statistics show a higher rate of defects in the cities in a proportion of 609 to 528. The higher fate in the cities is determined, however, by the prevalence of flatfoot. In general, the urban districts exceed in defects due to inferior stock and bad environmental conditions; the rural districts exceed in hereditary congenital defects. From a military point of view, the Northwest contains the best men of the country. — G. E. Partridge.

What is the American Standard of Living? *Royal Meeker.* Mod. Med., July, 1919, 1, No. 3, 193–199. — "From this very brief analysis of the data thus far worked up from the cost of living schedules it is very apparent that there is no such thing as the American standard of living in the sense of a very superior standard giving all the necessities, many of the comforts and a goodly supply of the luxuries of life. On the contrary it is found that there are as many different standards as there are different incomes and families of different sizes. In the lower income groups the living conditions are hard indeed. The incomes of the lower-paid workers must be increased and the cost of food, clothing, and housing must be lowered to enable these families to meet the high costs of existence. Social legislation is needed to give them better and cheaper food, clothing, houses, medical treatment, and insurance. Even in the higher income groups conditions are not as easy as they are frequently pictured to us. Let us not be fooled by the cry that the American standard of living is the highest in the world. Let the minimum living standard in America be one that will support life in decency and health." — C. K. Drinker.

Human Engineering — A New Medical Specialty. *Frank L. Rector.* U. S. Pub. Health Ser., Pub. Health Rep., Jan. 9, 1920, 35, No. 2, 61–65. — The duties of the industrial physician today must cover such a wide field of service that it would be somewhat more appropriate were he designated as the human engineer. He must be able to interpret industrial processes, understand the operation of mechanical appliances, size up the human requirements for filling a certain job, make scientific studies of the hazards of occupations, make certain that proper working conditions are provided for the industrial population, and interpret these findings in terms of increased production, decreased labor turnover, and healthier and happier workers. He should also be able to tune up the home, community and industrial environment so that each would bear its part of carrying forward the great commercial life of the nation. He comes into intimate contact with four departments of industry, namely, employment, safety, medicine and welfare. If he is fulfilling the obligations of his position, he must know intimately and well the workings of each branch of this group. By making a physical examination of applicants for employment, he exerts a direct influence upon the placing of workers. If he properly follows up accidents, he comes in contact with the safety department. Of course, he dominates the medical department and, if he has the proper interest in the worker away from his factory job, he must be familiar with what is being done in the home and community environment of the workman. — L. A. Shaw.

Opportunities for Industrial Surgeons. *R. M. Little.* Mod. Med., June, 1919, 1, No. 2, 118–121. — Three influences are making increased opportunities for industrial surgeons: (1) the growing intelligence and deep concern of employers for the health and well-being of their employees; (2) the compensation laws; (3) growing appreciation of the economic value

of health. No facts accompany the very general discussion of these points. — C. K. Drinker.

Education in Industrial Medicine. *Otto P. Geier.* Mod. Med., June, 1919, 1, No. 2, 133–136. — A brief statement of a proposed plan for instruction in industrial medicine in the University of Cincinnati. — C. K. Drinker.

New Developments in Industrial Medicine and its Future. *Harry E. Mock.* Mod. Med., July, 1919, 1, No. 3, 203–208. — A general statement giving the position of industrial medicine and indicating its probable future. — C. K. Drinker.

The Development of the State Departments of Health in Relation to Health Insurance and Industrial Hygiene. *Augustus B. Wadsworth.* Am. Jour. Pub. Health, Jan., 1920, 10, No. 1, 53–58. — Preventive medicine has developed so rapidly that it has greatly enlarged its scope in the conservation of the health of the community. Despite this wonderful development, preventive medicine has nevertheless progressed in a comparatively narrow field — the control of the infectious diseases. The infectious diseases are but a part and, from the economic point of view, a comparatively small part of preventable human sickness and disease. The diseases of adult life, constitutional diseases resulting from cardiac, renal and digestive disorders, cancers of all kinds, the occupational diseases, etc., are all to an extent preventable.

The three major functions of all public health work are regulation, education, and personal or community service. Chief of these is the personal or community service, but if this is to be made effective all three functions must be fully developed and carefully co-ordinated. Health insurance, as it has been tried in different countries, is generally recognized as a failure. It provides an unsatisfactory service for its beneficiaries, and is subject to abuses. It does not tend to increase the efficiency of the medical service which is rendered to its beneficiaries. In industrial medicine, however, conditions are quite different. Large industrial organizations employ physicians who are responsible for their work and who are well trained in it. The labor organizations have also caught the spirit of the times and many of them have their own corps of experts who are entering this field of preventive medicine. The scope of the service of such organization in preventive medicine might very easily be greatly extended with the co-operation of the state departments of health. The economic value of such work has been fully established. But this plan of industrial medicine fails to provide for the greater number of all employees who work in smaller places, nor is there any immediate prospect of securing such a well-organized medical service for all of the people, save through the agency and the development of the state organizations that already exist, mainly the departments of health. The state department of health provides a central nucleus from which educational and other necessary work can be organized and operated in the state through branch or local centers. Laboratories form excellent centers from which to reach and serve physicians of a district. By similarly co-operating with the institutions and hospitals of the district and also with all of the physicians engaged in industrial medicine in the district, such a center would tend to organize and standardize the work and to increase through broader and larger experience not only its own efficiency, but also the efficiency of every physician in the district.

In order to accomplish the best results, however, competent experts must be induced to enter the state service. Adequate salaries should be appropriated so that the state can secure the best talent, because it requires considerable additional experience and specialization in state work to appreciate the problems. Health departments, if they are to discharge properly their duties to the citizens, must maintain their work on the highest planes. They must have experts in every branch who are unquestionably competent. The full development of preventive medicine, if it is to be a part of public health work, must follow lines of investigation and research with a corps of trained experts in each branch of medicine. — H. F. Smyth.

The Increasing Socialization of Medicine. *Arthur Newsholme.* Survey, Jan. 3, 1920, 43, No. 10, 357–362. — The writer points out some of the important features of the development of socialized medicine in England. He calls attention to what has already been done along the lines of sanitation, and the treatment and segregation of contagious diseases by public and semi-public agencies.

Although the number of hospital beds in England is 4.9 per 1000 of population, this

hospital service is not properly distributed. The prevalence of hospitals in the larger communities has tended to bring urban and rural death rates to nearly the same level in spite of many factors which tend to make urban communities less healthful.

In outlining the public medical service at present provided for in England, the writer enumerates the following:

1. Medical attendance for destitute persons.
2. Institutional treatment of lunacy.
3. Increasing facilities for treatment of feebleminded.
4. A large amount of gratuitous treatment of infectious diseases.
5. Under the National Insurance Act a marked extension of sanatorium and hospital facilities for treatment of tuberculosis.
6. Special assistance through local agents in aid of maternity and child welfare.
7. Special facilities for diagnosis and treatment of venereal diseases made obligatory with larger local authorities.
8. Assistance to medical practitioners in bacteriological diagnosis, etc.
9. Medical examination of school children.

In concluding it is pointed out that "the state will year by year take an increasing hand in medical matters." Medical service will become more and more closely identified with the individual needs of communities. The hospital and dispensary will become educational centers as well as treatment centers. In order that this may be accomplished fully in the course of time, medical practitioners must be developed who will look upon problems of personal and community hygiene as seriously as they do upon the accepted medical practice of the present. — C. H. Paull.

Labor and Production. *H. B. Drury.* American Federationist, March, 1920, 27, No. 3, 237–244. — Work in the present stage is full of conflict, and most men find but little intrinsic interest in their occupations. What we need is to infuse into industry the spirit of co-operation. The whole modern labor movement in its origin and in its fundamental tendencies is a reaction against the mechanical and the merely profit-making aspects of industry. The basic needs of labor at the present time are: more efficient and abundant production of material goods, for which wide co-ordination is necessary; conditions that will preclude the possibility of work being physically, mentally, and morally destructive; proper sharing, on the part of labor, in the goods produced. Labor has been inclined to assume that production is of interest only to the employer. This attitude needs to be changed. All measures and every kind of organization that will tend to increase productivity are now demanded urgently. Why should not the field of industry be freed from friction and suspicion and become throughout devoted to achievement? — G. E. Partridge.

Vocational Guidance and the Theory of Probability. *H. D. Kitson.* The School Review, Feb., 1920, 28, No. 2, 143–150. — Although we have not found ways of selecting an occupation for the individual, we have developed methods for the selection of the individual for an occupation, with results so encouraging that investigators are inclined to neglect the older field and to minimize its possibilities. Quantitative statements in vocational guidance must be couched in terms of probability. Only thus can a scientific mode of procedure be developed. We need data of many kinds, for example, in regard to probability of income of trades and professions. By the aid of vocational tests we must calculate the chances of success of the individual in a given occupation. We must measure applicants with the tests for which we have secured norms from records of workers. Knowing the test score of the individual under consideration and knowing the chances that an individual standing in one percentile in the tests will stand in the corresponding percentile on a scale of occupational success, we shall be able to state in terms of probability the chances that the individual will stand in a given position in the occupation, so far as his ability is concerned. Along these lines, the use of scientific methods in vocational guidance is a realizable idea. It requires only a shift of emphasis from the needs of the employer to those of the individual, and the presentation of quantities in terms of probability. Much material for use in vocational guidance is already available, such as the publications of the U. S. Bureau of Labor, about physical measurements, wage scales, occupational risks and the like. — G. E. Partridge.

Vocational Guidance and Scholarship. *Jessie Hutsinpillar.* School and Society, Jan. 31, 1920, 11, No. 266, 125–129. — "Precisely,

my proposal is this: A vocational counsellor is to recommend promising children who, if unaided, could not, in reason, secure further training, for scanty maintenance scholarships from the federal government while in training for callings useful to society. . . . Mental tests are to be used in determining eligibility, rather than competitive examinations. He (the counsellor) is to be on the alert for aptitudes in the rarer callings. . . ." — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

MENTAL

The Mental Hygiene of Industry. *E. E. Southard.* Ind. Management, Feb., 1920, 59, No. 2, 100–106. — Although the idea of a mental hygiene of industry is relatively new, Dr. Southard has pointed out that in fact there is (1) a psychology of industry, (2) a psychiatry of industry, and (3) a field of psychiatric social work in industry. The personnel work of psychologists during the war has demonstrated over a broad field the value of scientific selection, while similar work in individual plants has shown the value of such procedure in industry. The psychiatrist in most cases has come to industry from the outside. It is pointed out, however, that the work done up to the present time warrants industrial concerns in including a psychiatrist on their regular staff. He would be of value in co-operating with the employment department, both in the selection and placement of new workers, and in the relocation and promotion of those already employed. He could be called upon to give advice and supervise treatment in the cases of employees who were temporarily in need of special attention.

Quoting from the studies of Dr. Herman Adler, the writer has pointed out that the problem of obtaining and retaining employment is often particularly serious in the cases of "individuals in the community who, for various reasons, are not able to regulate their conduct on the basis of experience." Although some of these persons are obviously institutional cases, others are capable of supporting themselves when placed properly with regard to environment and occupation.

Attention is called to evidence which points to the possibility that the types of labor which respond most readily to the leading of labor agitators are men who have departed from normal from a nervous or mental standpoint. On the other hand, the leaders in labor unrest would seem to grade high in intelligence.

Among the important points to which attention is called in the summary of this article are:

1. The "term mental hygiene is coming into general use to cover the expert activities of psychiatrists, . . . psychologists, . . . and various non-professional or semi-professional aides."
2. Industry is becoming more keenly interested in mental hygiene, as the study of personnel problems becomes more minute.
3. War experience has furnished very strong arguments in support of the value of mental hygiene in other fields.
4. The problems of human relations can be satisfactorily solved only when all agencies cooperate. This would bring together engineering, medical, psychological, and sociological experience.
5. Care must be taken not to accept the verdict of reactionaries as based upon experience. — C. H. Paull.

The Present Status of the Problem of Traumatic Neuroses. *Th. van Schelven.* Nederl. Tijdschr. v. Geneesk., Nov. 29, 1919, 63, 2d half, No. 22, 1703–1718. — This is a fifteen-page article based on the examination of 4000 Austro-Hungarian soldiers, the summary of which is as follows:

1. The term "traumatic neurosis" is inexact, since the neurosis is not caused by the physical trauma as such, but by the psychic reaction of the patient before, at the time of, or after the injury. At best one can speak of a psychic trauma as its cause.
2. Traumatic neuroses are curable when the symptoms are not yet fixed; they usually become fixed if not cured by suggestion.
3. The usual type of patient with a traumatic neurosis is generally well oriented as to his case and consciously tries to put through his desires.
4. The complaints of all sufferers from neuroses disappear as soon as a firm, unalterable

decision is arrived at, irrespective of how this turns out; they then get well anywhere up to two years, usually earlier.

5. The best form of pension for these patients is a not too high, gradually decreasing disbursement, which is to cease at the end of two years, without the possibility of an appeal on this decision. The physician must not, therefore, lightly assume responsibility when he makes this diagnosis. — N. C. Foot.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Coal-Mine Gases. Federal Board for Vocational Education. Bull. No. 39, Oct., 1919, 36.—This bulletin affords a practical knowledge of the fundamental facts of coal mining which it is necessary that miners should know for their own safety and for that of their fellow-workers. It is by no means a complete treatise on the subject, but is intended to present in a simple and easily understood manner the elementary facts regarding mine gases. — L. A. Shaw.

The Disinfecting Power of HCN. *Emil v. Skramlik.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1919, 83, 387. — It is emphasized that the process of vermin extermination must be considered as distinct from disinfection; each of these procedures is based on entirely different principles. Bacteria are similar to members of the plant kingdom in their resistance to HCN. This gas kills some organisms, but has only a retarding effect on others. As a germicide, it appears to be at least eighty-five times as weak as HCl. — Barnett Cohen.

Poisoning by Hydrocyanic Acid Gas, with Special Reference to its Effect on the Brain. *Samuel W. Lambert.* Neurological Bulletin, March, 1919, 11, No. 93. Reviewed in Arch. Neurol. and Psychiat., Dec., 1919, 2, No. 6, 710–711. — An Italian disinfector was found unconscious in a room filled with hydrocyanic acid gas. The immediate symptoms were stertorous breathing, flushed skin, engorged and red veins, contracted pupils and rigid muscles. Later there was free sweating and muscular twitching. The man lived for sixteen days after the poisoning, showing rigid muscles, occasional convulsions, sweating, fever, tremor, ataxia and aphasia. Autopsy showed nephritis, adherent meninges and multiple small cerebral hemorrhages. Microscopically the Betz cells showed cloudy swelling, the Purkinje cells had largely disappeared, and there was gliosis in the pontal lobes. — S. Cobb.

Lead Poisoning — A Brief on the Symptoms, Diagnosis, and Treatment. *R. P. Albaugh.* Mod. Med., June, 1919, 1, No. 2, 137–138.—A concise summary of the effects of lead. — C. K. Drinker.

Lead Poisoning as a Factor in Chronic Disability. *E. B. Starr.* Ohio Pub. Health Jour., Oct., 1919, 10, No. 10, 384–386. — Lead poisoning is the most thoroughly studied and the commonest of all occupational poisonings. Dr. Alice Hamilton found seventy industries in Illinois to which lead poisoning could be traced. There is practically no industry in which lead is not used at some time. Tables are here appended showing the influence of length of exposure and the influence of especially hazardous processes.

By far the great majority of occupational diseases are of chronic nature and are seldom diagnosed as such. If industrial workers are to receive the best medical services, the doctor will need to take more interest in the occupational phase of his patient's life than is ordinarily manifested. He must inquire in every obscure chronic case concerning the hours of labor and the amount of sleep, the particular process involved in the patient's work, what materials enter into the process, the length of employment and exposure to hazards, whether the work place is overcrowded, underlighted or insufficiently ventilated, etc. Every practicing physician should provide himself with some standard work to which he can refer, as occasion demands, for information which will give him an understanding of these subjects. — L. A. Shaw.

The Share of Lead and Zinc in the Zinc Plant Sickness, with Remarks on Hygienic Measures in Zinc Plants. *Seiffert.* Öffentliche Gesundheitspflege, 1918, 3, No. 3, 85–98. Reviewed in Metall und Erz, Sept. 22, 1919, 16, No. 18, 426–428. — In zinc plants the so-called "zinc plant sickness" often occurs. It consists in a pallid appearance, loss of weight, failing strength, stomach and bowel troubles, nervousness, bluish tint of the gums, pains in the joints; often paralysis and muscular de-

generation, etc., also occur. But all these symptoms do not occur together in every case. Lead, to the poisonous effect of which the zinc worker is constantly exposed, has a prominent part in the origin of the sickness; but it is not the only cause of the sickness, as has been generally assumed till very recently. The "Councillor of Hygiene," Dr. Seiffert, proves in his lengthy treatise that other metallic poisons besides lead are responsible for the sickness, especially zinc, which has been generally considered harmless. The majority of the symptoms of chronic poisoning, which were formerly only known to be due to lead, have now been detected in the case of other heavy metals. Seiffert found zinc even more frequently than lead in the urine of sixty-nine sick workmen whom he examined. Forty of these workmen (58 per cent.) proved to have metals in their urine; 25 (36.2 per cent.) had zinc only; 2 (2.9 per cent.) had lead only; 13 (18.8 per cent.) had both zinc and lead. Thus 38, or 55 per cent., had zinc, and 15, or 21.7 per cent., had lead. There were only two cases among those in which lead was detected in the urine, in which lead poisoning was *certainly* present; there was only one case among the fifteen in which the general symptoms of chronic illness were especially prominent and severe. In severe cases, it was exceptional for lead to be excreted; but it is not to be assumed that the body retains the lead in these cases, and easily expels it in the others. Zinc is superior to lead not only in the number of cases, but also in the quantity of the metal found in the urine. Disregarding the cases in which the quantity of metal excreted was too minute to weigh, there was on an average 3 mg. of zinc per liter of urine, but only 0.16 mg. of lead. Seiffert rejects the objection that small quantities of lead can have a more dangerous effect than large quantities of zinc; he rather thinks that the human body has a great power of tolerating or resisting lead. Among other facts, the rarity of lead poisoning among typesetters constantly exposed to lead proves this.

In those zinc plants with which Seiffert is personally acquainted, metallic lead is absorbed almost entirely by way of the stomach and the bowels; even the lead salts which are insoluble in water do not penetrate the body in any other way. But in such a case the organism soon frees itself of most of the poison, which is transformed to lead sulphide — considered non-poisonous — in the bowels, and is then rejected again unchanged in the excrement. In and around the zinc plants this process should be facilitated by the considerable quantities of sulphur dioxide present in the air. However, when lead is constantly present in the stomach and bowels part is absorbed under conditions which are still unknown; this, as well as the soluble poison introduced with food and drink and that breathed in by the lungs in the form of lead fumes, gets into the blood. The portion of this lead not excreted again either by the gall-bladder into the bowels, or by the kidneys into the bladder, or by the skin to the surface of the body, is brought by the circulating blood into all the organs of the body, where it can exercise its destructive effects. Also, deposits of lead are formed in various organs, from which renewed destruction of tissue spreads. So it happens that alterations and lesions of organs do not appear at once with symptoms of poisoning; the alterations and lesions cause only a general and gradually increasing sickness. The storage organs of the body operate as lead filters and prevent the bodily fluids (and mainly the blood) from being over-filled with the metallic poison. A surplus of lead in the blood, with its dangerous consequences for the red corpuscles, only occurs when these storage organs are insufficient, fail to act, or are over-filled. The varying power of resistance to lead poisoning, found among workmen, may be due to more or less efficient functioning of these storage organs, as well as to the greater power of resistance of the cells. Otherwise it is inexplicable that in many workmen severe symptoms of illness occur after brief employment, in others only after many years; also, that the objective symptoms of lead poisoning are extremely inconsistent and variable in different workmen, and may be either mild or very severe. The general constitution and way of living also are certainly factors in this matter.

Zinc is absorbed into the body in the form of gas and dust. Up to the present, the absorption of the vapors alone was considered dangerous; however, injurious effects which can be attributed to nothing but zinc, have been observed in workmen who have not been exposed to zinc vapors. The injuries due to zinc vapors occur only immediately at the ovens and in smelting; they only affect special classes of workmen, who are in fact more often poisoned than the others (smelters, and those engaged in the actual tending of the muffle furnaces). The fact that their injuries are not still more exten-

sive and severe is due to the considerable supply of atmospheric oxygen present, as well as to the cooling and resulting low density of the gases; the zinc solidifies on its way to the lung tissue, and can be expelled from the lungs (which have little power to absorb it) by coughing.

Seiffert regards the zinc which gets into the body in the form of dust as the chief enemy which constantly harms the zinc worker. The constant, though slight, absorption produces the sickness gradually. Most of the injurious effects are due to the dust from blende and calomine, with its great quantities of zinc sulphate and carbonate. The former is soluble in water, the latter in dilute acids. Zinc-albumen compounds are formed which penetrate the blood without difficulty.

The tolerance of the organism for zinc is likewise great, certainly greater than its tolerance for lead. Comparatively great quantities of zinc can be excreted for a long time from the kidneys and other organs, without affecting even temporarily the ability to work. Seiffert gives many examples which show that the deposits of zinc in the body are often very large, and yet threaten no immediate danger to life. The storage organs do not become insufficient and the system does not become poisoned till the collections of metal have become too large; this had occurred in most of those cases in which a considerable excretion of zinc could be detected in the urine.

The picture of zinc plant sickness is not unified. In one group of patients stomach and bowel troubles are prominent; in another, nervous troubles; and in still others, pains in the kidneys or joints or back. The symptoms are generally mixed. The explanation of this is that the resisting power of the various organs varies from person to person; varying age, the unequal effect of cleanliness, dwelling conditions, nutrition, etc., are also important factors. Seiffert's remarks show that it is necessary to protect the workman still more; the injurious effects of zinc must be prevented, as well as those of lead; the effect of arsenic, antimony, copper and gases (carbon monoxide, sulphur dioxide) must also be considered. The regulations of the Bundesrat (German Federal Council) of Feb. 6, 1900, and the later additional regulations have resulted in a marked improvement in the hygienic conditions in upper Silesia, as these measures compelled the modernizing of the plants. Still, many more things must be done to diminish the existing danger to health.

Note by the editor of Metall und Erz. — "We are very sceptical of Seiffert's theory that zinc, as well as lead, poisons the workers in zinc plants. To prevent any alarm in the zinc industry which might be caused by Seiffert's contentions, we have communicated with the Institute for Industrial Hygiene. This Institute, with the Department of Health, will settle the matter." — J. A. Singmaster.

Hygienic Control of the Anilin Dye Industry in Europe. *Alice Hamilton.* U. S. Bur. Labor Statis., Month. Labor Rev., Dec., 1919, 9, No. 6, 1–21. — This report is the result of studies made, at the request of the Commissioner of Labor Statistics, of representative dye plants in France, Switzerland, Germany, and England during the spring and summer of 1919. The purpose was to see what measures are taken in these countries to protect workers against the dangers of industrial poisoning. America's dependence upon Europe for a knowledge of the poisonous effects of dyes is emphasized. (For the essential features of poisonings resulting from the manufacture of dyes, see the author's article in the Monthly Labor Review for February, 1919.) The following toxic substances are briefly discussed as observed in use in European plants, and a number of interesting and illustrative case histories are included: benzene (C_6H_6); anilin ($C_6H_5NH_2$); chlorbenzenes; miscellaneous compounds of the benzene ring; dinitrophenol ($C_6H_3HO(NO_2)_2$); dimethyl sulphate ($(CH_3)_2SO_4$); phosgene or carbonyl chloride ($COCl_2$); chromates; hydrogen arsenide (AsH_3).

Sections follow on *The Methods of Prevention of Occupational Poisoning; Attention to Feeding Employees; Wash Rooms and Working Clothes; Medical Supervision.* — R. B. Crain.

A Report of Five Cases of Poisoning by Nicotine. *William D. McNally.* Jour. Lab. and Clin. Med., Jan., 1920, 5, No. 4, 213–217. — After reviewing the literature, McNally reports five cases of poisoning by nicotine. In all cases death occurred from having taken by mistake insecticides containing nicotine. The free alkaloid is a colorless, oily liquid which rapidly becomes brown in color, closely resembling whiskey, which accounts for its accidental consumption. Three of the cases occurred in men employed in greenhouses. In all cases, death resulted within a few minutes. — H. A. Bulger.

DUST HAZARDS AND THEIR EFFECTS

Removal of Dust, Fumes and Gases from Factory Workrooms. *Robert Northrup.* Safety Engin., Jan., 1920, 39, No. 1, 18–23. — An article dealing with the procedure used by the New York State Industrial Commission when an order is issued to remove excess dust, fumes and gases. By this procedure a great gain in the efficiency of exhaust work has been accomplished, and the manufacturer is assured that his investment in dust removal apparatus will result in the required efficiency. — R. Thomson.

Dust Exhaust System at Arizona Copper Co. Mill. *R. M. Hull.* Chem. and Metall. Engin., Feb. 4, 1920, 22, No. 5, 207–208. — The dust exhaust system, installed for the purpose of improving the working conditions in the plant, is described. The amount of dust collected in a series of tests equaled 0.087 tons, or 0.0367 per cent. of the ore crushed. — G. M. Fair.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Tuberculosis — A City Plan. *C. V. Craster.* Jour. Am. Med. Assn., Jan. 31, 1920, 74, No. 5, 302–306. — Despite previous knowledge regarding tuberculosis, the mortality, although decreasing, is still too large. The prevalence of the disease has continued and so far we have failed to control it. The following city plan for tuberculosis control is suggested:

A. Control of infection by (1) requiring reports from physicians, hospitals, sanatoriums, day camps and tents, and field nurses; (2) enforcement of anti-spitting laws; and (3) milk supervision.

B. Social progress by (1) publicity; (2) social insurance; (3) anti-tuberculosis societies program; and (4) home visiting and relief.

C. Economic improvement through (1) improved housing; (2) industrial hygiene; (3) open air schools; (4) vocational training; and (5) employment bureaus.

D. Associated activities including (1) control of epidemics (measles, whooping cough, etc.); (2) convalescent homes; (3) child hygiene; and (4) mental hygiene. — W. Herman.

Influenza — When the City is a Great Field Hospital. *Lillian D. Wald.* Survey, Feb. 14, 1920, 43, No. 16, 579–581. — The title of this article seems to be unfortunately chosen, in view of the fact that the article deals with the organization of a centralized type of community health service, which is of interest primarily not because of the need which called it into existence, but because of the effectiveness with which it continues to function. With the breaking out of the influenza epidemic in the fall of 1918, the Nurses' Emergency Council was created. The necessity for a community organization was emphasized not only by the epidemic, but also by the scarcity of nurses.

Within twenty-four hours, this emergency council had so successfully drawn its forces together that it was ready to function. Through its activities it was able to co-ordinate work in the various city districts which it established. The work of the limited number of available nurses was supplemented by volunteers who had little or no special training.

At the request of the commissioner of health, the Nurses' Emergency Council has become a permanent organization. Its work has developed so that in the case of the influenza epidemic of this year it was able without increased organization to extend its service through the various agencies which it includes. In spite of the excellent work which this body has accomplished, its activities have been limited by the number of nurses and the amount of funds available. Its work, however, has demonstrated the practical value and effectiveness of this form of centrally organized community service. — C. H. Paull.

Pulmonary Anthrax: Report of a Case. *W. R. Brooksher, Jr.* and *J. A. Briggs.* Jour. Am. Med. Assn., Jan. 31, 1920, 74, No. 5, 323–324. — The authors report a case of pulmonary anthrax in a tannery worker who had been handling green hides. The diagnosis depended rather on the notation of subjective than on the

elicitation of objective signs. The following conclusions are given:

1. Diagnosis of pulmonary anthrax is only possible in positive laboratory findings; sputum examinations and blood cultures are the means employed.

2. Early diagnosis and treatment with anti-anthrax serum by intravenous injection offers the only hope of recovery.

3. Pulmonary anthrax may appear without the evidences of a violent pneumonia and yet prove fatal as a result of a decided clinical toxemia. — W. Herman.

Observations Based on Feces Examinations on the Occurrence of Intestinal Parasites in Troops and War Prisoners. *R. Vogel.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1919, 83, 486. — One hundred examinations in a regiment that had fought on the western, eastern and southern German fronts showed 75 per cent. infected with intestinal worms. There were 63 per cent. with Ascaris lumbricoides, 41 per cent. with Trichocephalus dispar (29 per cent. had a mixed infection of both the above parasites), and 3 per cent. also contained Tenia in addition to the others. Fifty examinations were made on a company of bakers on the western front. Of these, 66 per cent. were infected. Thirty per cent. had Ascaris, 60 per cent. Trichocephalus, and 30 per cent. had a mixed infection of these two worms. Fifty-six examinations on Russian prisoners showed 50 per cent. infected. There were 50 per cent. of these with Trichocephalus and 14 per cent. with Ascaris. One of the striking results of this study was the complete absence of Oxyuris in any of the groups. — Barnett Cohen.

Occurrence and Number of Worm Eggs in Stools as Observed in the Wounded, Sick and Attendants of a Field Hospital. *Albert Gmelin.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1919, 83, 460. — Crowding greatly facilitates the spread of intestinal worm infection in adults as well as in children. Trichocephalus dispar was most prevalent, occurring in 18.5 per cent. of the cases, while next in order came Oxyuris vermicularis with a frequency of 18.4 per cent. Ascaris was present in 12 per cent. of the cases, Tenias in 2.4 per cent., and aguillula intestinalis in 1.8 per cent. From the epidemiological standpoint, it is important to note that field bakers had a higher percentage of infection, though resulting serious clinical disturbances were not observed in them. — Barnett Cohen.

The Municipality's Share in Preventing Venereal Disease. *George W. Goler.* Nat. Munic. Rev., Feb., 1920, 9, No. 2, 74–77. — Among the statistical material introduced in this article to call attention to the seriousness of venereal disease may be noted:

1. "Of 25,633 cases of infectious diseases reported in New York City, 28 per cent. were syphilis."

2. "From 4 to 15 per cent. of insane in state hospitals or institutions for the insane are there because of syphilis."

3. Careful investigation has established the belief that 10 per cent. of marriages involve a syphilitic individual.

The danger of syphilis lies not only in the disease as it is commonly recognized, but also in diseases of the heart, kidney, and liver. The effects of venereal diseases in parents are particularly obvious in the large number of deaths of infants, before, at, and just after birth.

Among the functions of the municipality in combating venereal disease, the writer suggests:

1. Suppression of all forms of prostitution.

2. Provision for the free examination of all persons before marriage and prevention of marriage in case of those affected by venereal diseases.

3. Establishment of laboratories and clinics through which physicians could work.

4. Compulsory attendance at clinics or at the office of a physician.

5. Systematic re-examination of those who have been affected with venereal diseases.

6. Ultimate provision for autopsy and laboratory study of those who die within the municipality.

The necessity for such a program as this is pointed out as having its basis in the needs of society as well as in those of the individual. The supply of population from abroad will tend to decrease, and we must place more value upon population developed in our own country. — C. H. Paull.

Statistical Study of Extragenital Chancres. *Horace W. Porter.* Arch. Dermat. and Syph., Jan., 1920, 38, N. S. 1, No. 1, 15–22. — Out of 225 patients presenting themselves with a chancre as the chief complaint, fifty-four had extragenital sores, giving the high rate of 24.5

per cent. Only nine patients were able to state the source definitely. The relative location was as follows: lips 31, tongue 6, eyelids 2, cheek 2, angle of mouth 1, nose 1, temple 1, forehead 1, tonsil 1, thumb 2, breast 2, abdomen 2, and arms 2. As in cases reported by other men, married females predominated and unmarried men ranked next. — H. A. Bulger.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Report of a Case of Dermatitis Coccidiosa. *J. Seilin.* Med. Rec., March 1, 1919, 95, No. 9, 360–361. — Seilin reports a case of dermatitis coccidiosa occurring in a cigar-maker on the hand used for rolling the tobacco. The case was one of purely localized dermatitis for nine years, with periods of spontaneous improvement and exacerbations, and when treated by Seilin was cured promptly by local applications of 1 per cent. copper sulphate ointment and internal administration of potassium iodide with hypodermics of emetine chloride. — K. R. Drinker.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Industrial Safety Code Conference. Jour. Am. Soc. Electrical Engineers, Jan., 1920, 39, No. 1, 79–80. — A report of the conference on industrial safety codes held at the Bureau of Standards, Washington, D. C., in December, 1919. — G. M. Fair.

Industrial Fatigue Research Board. Engin., Jan. 2, 1920, 109, No. 218. — This critical review of the Fourth Report of the Industrial Fatigue Research Board of Great Britain relating to "the incidence of industrial accidents upon individuals with special reference to multiple accidents" claims that the conclusions of the investigators are based upon concealed and incomplete classification of facts and are therefore worthless. The conclusions arrived at are that accidents do not happen according to the laws of pure chance, and also that some people are naturally more liable to meet with accidents than others. It is further considered to be proved that the victim of one accident is neither more nor less liable to meet with another as a result of his experience. — G. M. Fair.

Public Accidents and their Cost. *Frederick S. Crum.* Safety Engin., Dec., 1919, 38, No. 6, 327–328. — In a very brief paper the author calls attention to the high percentage of public accidents. From the study of occupational, home, and public accidents as well as from general knowledge and experience, it seems reasonably certain that fully one-half of all the accidental fatalities are chargeable to public accidents. To check the enormous losses of lives and property due to public accidents, however, the facts must be placed before the public in a clearer light. To this end, the committee on statistics of the National Safety Council, of which committee the author is chairman, is trying to develop a blank form for the better reporting and recording of public accidents, by means of which information may be placed before the public, the truth of which will be undeniable and the significance of which will be so startling that a much wider co-operation between the government and the public for the prevention of public accidents will result. — R. Thomson.

A Method of Safety Education. *R. A. Shaw.* Safety Engin., Dec., 1919, 38, No. 6, 341–342.— A system of safety education that has proved successful in the Ford Motor Company is outlined in this paper. A striking decrease in accidents is shown by a comparison of the months of October, 1916, and May, 1919, when there were 194 and 40 accidents respectively — a reduction of nearly 80 per cent. in three years, while the number of employees increased 18 per cent. — R. Thomson.

What Constitutes Good Inspection? *Lew R. Palmer.* Safety Engin., Dec., 1919, 38, No. 6, 323–326. — The safety inspector must not only possess tact and apt observation, but must have training and practical experience that will enable him to justify his recommendations. In many instances, the correction of unsafe and unhealthy conditions can be combined with improved operating methods pro-

vided there is close co-operation between the engineer and the safety inspector. New inspectors should become familiar with the safety standards developed by the various compensation insurance companies in co-operation with the leading industrial states. A list of the items covered in these standards is included in this article, as is also a list of safe practices pamphlets published by the National Safety Council and of safety specifications for plant construction and equipment prepared by the U. S. Shipping Board Emergency Fleet Corporation. These publications furnish the foundation from which can be developed comprehensive and practical safety recommendations. — R. Thomson.

Who Won the 12 Years' War on Accidents? *C. W. Price.* Factory, Feb. 15, 1920, 24, No. 3, 456–458. — Mr. Price, general manager of the National Safety Council, points out some of the elements of progress in accident prevention. Particularly interesting are the charts reproduced from the records of the Scovill Manufacturing Company and the Packard Motor Car Company.

Drawing upon the experience of the past, Mr. Price outlines some fundamentals of accident prevention in industry:

1. The management must be sincerely behind all safety work.
2. "One man should be made responsible for safety work in every plant."
3. Plant committees of from three to five members will aid in relieving the management of many details.
4. The attitude of the worker depends largely upon the attitude of the foremen.
5. Interest among workmen is conditioned to a degree by responsibility placed upon them.
6. In hazardous departments special committees of workers should be formed.
7. Bulletin and similar service is valuable.
8. Safety will never succeed fully until it has been carried into the community life of the workers. — C. H. Paull.

Clumsiness, a Cause of Accidents. *Val Klammer.* Safety Engin., Jan., 1920, 39, No. 1, 27–29. — In an analysis of the principal causes of clumsiness, the following reasons are given: malformation, previous injury, defective vision, poor hand and eye co-ordination, mental deficiency, disease, fatigue, excitement, mind-wandering, laziness, intemperance, inexperience, and old age. By periodic physical examinations of employees, physiological tests, and co-operation between the employment office and the safety department, the solution of the problem of putting the right man in the right place may be accomplished. — R. Thomson.

Preventing Accidents in Gas Plants. *J. F. Conner.* Safety Engin., Dec., 1919, 38, No. 6, 328–329. — Precautions in the form of sufficient ventilation and lighting, and approved lighting systems should be taken against pockets of gas accumulating in gas works. Like precautions should be taken to guard against dust explosions in coal-crusher rooms and pits where the air is heavily charged with minute particles of carbon which may ignite and explode by contact with a naked flame. In cases where a man has to work in a gas-charged atmosphere, he should be supplied with a suitable respirator and be under the observation of someone outside the danger zone. The greater number of accidents are due to simple hazards, and only by continued educational propaganda and by safety rallies is it possible to attract and maintain interest in accident prevention. — R. Thomson.

Safe Practice in Using Gas Masks. *A. C. Fieldner* and *S. H. Katz.* Safety Engin., Dec., 1919, 38, No. 6, 318–319. — The army-type gas mask, with a suitably filled canister for the gas in question, provides complete protection for both lungs and eyes. The gas mask is not, however, a cure-all for every gaseous atmosphere. It has serious limitations which should be thoroughly understood by every user. In conclusion, the authors offer some important recommendations which will aid in keeping the masks in good order and will lead to their use under proper and safe conditions. — R. Thomson.

INDUSTRIAL SURGERY

Treatment of Denervated Muscle. *Frank A. Hartman* and *W. E. Blatz.* Jour. Am. Med. Assn., March 27, 1920, 74, No. 13, 878–880. — "The sciatic or tibial nerve was cut or crushed on both sides of 123 rabbits. The denervated muscles on the right side were either massaged

(eighty-six cases) or else stimulated by galvanic shocks (thirty-seven cases), daily.

"Union of the cut nerve was prevented in forty-one animals, and in the others it was favored by suture or by crushing instead of cutting. The right and left muscle groups were compared from every ten to fourteen days by a determination of their power to do work when stimulated by supermaximal galvanic shocks while the animals were under the influence of ether.

"Neither massage nor galvanic stimulation prevented the loss in galvanic response which normally develops a few days after denervation. Treatment likewise did not appear to cause a more rapid recovery of the muscle when the nerves were permitted to grow down to the muscle fibers. Galvanic response and voluntary function in the denervated muscle returned much earlier in crushed nerve cases than in cut and sutured cases.

"In all of our work we have been unable to demonstrate benefit from massage or galvanic stimulation." — C. K. Drinker.

"Flat Foot" and Other Static Foot Troubles. *Frederic J. Cotton.* Boston Med. and Surg. Jour., Jan. 1, 1920, 182, No. 1, 1–11. — The author summarizes his article as follows:

"1. Most foot troubles are physiological — 'static' in origin.

"2. In a large share, bad shoes are responsible.

"3. In many, bad habits in use of the feet are responsible.

"4. In cases of Class 1a (habitual flat foot) decent shoes and properly supervised exercises, properly carried out, will bring about a *cure* in a very large percentage — probably a majority — of cases, certainly in a majority of the younger cases — below 25 years of age.

"5. These are the cases to which plates are too often applied.

"6. Plates are still too much used.

"7. Plates help, but never cure.

"8. 'Flat-foot' cases, as we meet them, call for either physiological cure — palliation by straps, plates, etc., then systematic exercise, or else they do ill under the routine and call for more or less permanent support — or (rather rarely) for radical correction by manipulation or by open operation.

"9. Anterior-arch troubles are readily relievable, as a rule — very often not curable.

"10. Hallux valgus (and hallux rigidus) may be palliated effectively but can be cured only by surgery." — K. R. Drinker.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Prevention of Fatigue in Industry — I. So-Called Tests for Fatigue are of Doubtful Value. *Reynold A. Spaeth.* Ind. Management, Jan., 1920, 59, No. 1, 7–9. — This is the first of a series of articles prepared by Dr. Spaeth on fatigue. He calls attention to the fact that as yet there has been no means devised for determining when, in the case of individuals, normal fatigue (such as can be dispelled by proper sleep, food, etc.) passes over the threshold into cumulative fatigue (such as will lead to a serious pathological condition if allowed to continue). Although the body does respond to stop effort resulting in extreme fatigue, this response cannot be relied upon to take place before the limits of normal fatigue have been passed.

Partly because of its evasive qualities we have failed to look upon cumulative fatigue as one of the most serious health hazards in industry. As a health hazard the most serious characteristics of fatigue are: "(1) the difficulty of detecting it in its earlier stages; (2) the fact that a 'nervous breakdown' frequently means a permanent injury to health; (3) the fact that . . . cumulative fatigue is not well understood and neither the symptoms nor the treatment have received the attention they deserve."

Attention is called to the fallacy of relying upon production statistics as an indication of fatigue. The common idea that decline in production gives a check upon fatigue seems to be discredited by recent observation and study. In the case of some workers it is apparent that production actually increases with fatigue within certain limits. While the stimulation given by the offering of material or other incentives to work may lead to a wholly desirable increase in production, care must be taken not to induce individual workers or groups of workers to call upon their reserve store of energy.

From the standpoint of the industry, the net results of "long continued cumulative fatigue

and over stimulation are: (1) breakdown . . ., (2) loss of workers in turnover, (3) shortening of trade life." — C. H. Paull.

Prevention of Fatigue in Industry — II. Reduction of Unnecessary Fatigue. *Reynold A. Spaeth.* Ind. Management, Feb., 1920, 59, No. 2, 120–122. — Attention is called in the first paragraph of this article to the difference between normal and cumulative fatigue. Since cumulative fatigue is an outgrowth of certain conditions of normal fatigue, the obvious first point of attack upon either is through normal fatigue.

The avoidance and elimination of much of the normal fatigue in industry, when properly carried out, results in gain both to the worker and to the industry. Under ordinary conditions of work the elimination of eye strain furnishes an excellent point of departure in eliminating unnecessary fatigue elements. Another important factor in fatigue is the character of seating facilities provided. Where his work permits of his being seated for a whole or part of the day, the employee should be furnished not only with a seat, but with a seat especially adapted to his particular physical needs. Proper support should be furnished the back and the chair should permit the worker to place his feet squarely on the floor.

The question of rest periods is one which can be solved only by studying the particular needs of each job. Where nervous strain or physical exertion are continuous, the rest period is commonly advantageous, but where the worker has periodic opportunities to relax in his work, rest periods do not seem to be necessary. Where work is paid for on a piece basis, it is often necessary to demonstrate to the workers that rest periods actually react to their advantage in making production easier or in increasing it.

Attention is called to the fact that, even though production may not be increased in certain instances by rest periods, still the reaction upon the worker may be thoroughly beneficial. — C. H. Paull.

WOMEN AND CHILDREN IN INDUSTRY

The Menace of Child Labor. *Christine R. Kefauver.* Month. Bull. N. Y. City Dept. Health, Dec., 1919, 9, No. 12, 281–294. — In this article child labor is divided into six classes, each of which is treated separately. Suggestions whereby the existing regulations may be improved are offered in a résumé on page 288. The child labor laws of the state of New York and the mode of administrating them are herein summarized. — L. A. Shaw.

The Future of Boy-Work. *S. J. Gibb.* The Child, Jan., 1920, 10, No. 4, 151–155.— The writer's conclusion is that the problem of boy-work is personal and not merely economic. We must give more attention to the blind-alleys — such work as has no outlook for the individual. The ultimate cause of the modern problem of boy-work is a false conception of the status of the boy-worker. The boy-worker has lost his status as an apprentice and a pupil, and has become a wage-earner. Training, if given at all, is secondary. The problem will not approach solution until the principle of the young worker as a pupil is restored and embodied in a system adapted to present conditions. The first need is education, progressive from childhood to youth, and in later years embedded in the working life. The Education Act of 1918 supplies this need. The second need is the ordering of vocational choice and entrance upon work. The average boy does not choose his work; he lights upon it. He seeks a job, not the vocation for which he is naturally apt. Each local education authority should be compelled to establish a juvenile employment bureau for its area, and sometime before leaving school each child should visit the employment bureau for examination and advice. Each boy should be kept in sight during his early working years, and the employment bureau should be recognized as the normal means for finding or changing work up to the age of 18. Legislation controlling juvenile hours of work needs to be extended and strengthened. Conferences between employers and employed in trades and commerce should aim at determining the needs and the best means of vocational and technical training in the course of work. There must be welfare supervision for boys and girls in industry. — G. E. Partridge.

Very Bright and Feeble-Minded Children: The Study of Qualitative Differences. *C. T. Jones.* The Training School Bulletin, Dec., 1919, 16, No. 8, 137–141; Jan.,

1920, 16, No. 9, 153–164. — The study has no direct application to the measurement of intelligence of the adult subject, but is of interest because of the data on qualitative differences of intelligence which it contains. — G. E. Partridge.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Factory Design in England. Am. Arch., Jan. 28, 1920, 117, No. 2301, 116. — An illustrated article dealing with a number of examples of factory construction in England. — G. M. Fair.

Factory Stairs and Stairways. *G. L. H. Arnold.* Am. Arch., 117, Part I, Jan. 28, 1920, No. 2301, 129–134; Part II, Feb. 4, 1920, No. 2302, 161–164. — In the multi-story factory the stairway is a detail worth much more than passing notice. Four times daily the stairs are crowded by people in a hurry. A large percentage of minor accidents, many of the serious ones, and many panics in factories happen on the stairs. A properly designed and located stairway affords not only a safe and convenient means of entrance and exit but also the handiest and most effective vantage point from which to fight fires on the upper floors. For these reasons the design of the stairway should be given a place of prime importance in the planning of factory buildings. In solving the stairway problem Mr. Arnold gives consideration to: number; location; size; type; materials; safety treads; proportions; landings; handrails; enclosures; lighting; and wear. — G. M. Fair.

Plans of the Illuminating Engineering Society for 1920. *S. E. Doane.* Electrical Rev. (Chicago), Jan. 3, 1920, 76, No. 1, 15–16. — Besides other activities it is the plan of the Illuminating Engineering Society to so broaden its educational work that all dealing with lighting may do so intelligently. — G. M. Fair.

Survey of Prevailing Conditions as to Industrial Lighting. Electrical Rev. (Chicago), 76, Part I, Jan. 24, 1920, No. 4, 139–141; Part II, Jan. 31, 1920, No. 5, 180–183; Part III, Feb. 7, 1920, No. 6, 222–227. — This article is a summary of the *Survey of Prevailing Conditions as to Industrial Lighting* made under the direction of the National Lamp Works and recorded in a volume of some 200 pages, including over fifty graphic charts. The main purpose of the survey was to obtain an accurate idea of the true status of factory lighting now prevailing in representative plants of the principal industrial sections of the country. Fifty-seven cities and towns were visited and 446 different plants inspected. The principal questions on which information was obtained were:

A. Features of identification (to provide a basis for cross analysis).
B. Equipment.
C. Specific history of last lighting changes.
D. Control of lighting business (officers or personnel).
E. Disposition toward industrial lighting (officers or personnel).
F. Observations in plant (actual condition of system).
G. General (proportion of work done under artificial light and costs).
H. Advertising influences.

Statistical material is presented in answer to each question. — G. M. Fair.

Possibilities of Industrial Lighting. *R. O. Eastman.* Electrical World, Jan. 31, 1920, 75, No. 5, 263–264. — A paper presented before the Thirteenth Annual Convention of the Illuminating Engineering Society and based upon the Industrial Lighting Survey abstracted from the Electrical Review, Vol. 76, Nos. 4, 5, 6 (see preceding abstract). Mr. Eastman presents the findings of the survey in graphical and tabular form. It is of interest to industrial hygienists that the weight assigned to improved hygienic conditions and accident prevention as a result of good lighting is 4 and 6 per cent. respectively. — G. M. Fair.

Development of Factory Lighting. *George C. Ward.* Safety Engin., Dec., 1919, 38, No. 6, 320–322. — This article deals with the work of the New York State Industrial Commission in improving the lighting of factories and mercantile establishments. The conditions to be avoided are treated under the following heads: (1) glare, (2) flickering light, (3) insufficient light, and (4) sharp contrasts. Emphasis is laid on the fact that much lower wattage

lamps, properly equipped with shades and reflectors and properly placed, will produce the same amount of foot-candle illumination on the working plane as the higher wattage lamps, hanging open, unshaded and unprotected from glare, actually produce. That accidents are undoubtedly caused by defects in illumination has been shown by insurance company records. Data collected show that in December and January the accident curve is 40 per cent. greater than the normal curve for summer daylight.

The ideal lighting system should combine general and local lighting designed to fit the needs of the particular room where it is to be used, should eliminate direct and reflected glare by proper placement and proper diffusion, should minimize the loss of light by absorption in dark walls and ceilings, should have lights so arranged that no black shadows are encountered and so that a uniform diffusion of the required intensity is spread over the entire area, and lastly, should employ local lights only where actually needed. The advantages of such a system include increased production, reduction in spoilage, increased excellence of workmanship, and better wages.—R. Thomson.

Value of Light has at last been Recognized. *Ward Harrison.* Electrical World, Jan. 17, 1920, 75, No. 3, 146–148. — During 1919 illumination has taken its place among other standard agencies for increasing production and conserving energy. While this transition from the vague to the definite is marked by the use of proper intensities of illumination, it is not equally conspicuous in the elimination of glare which, although better understood and applied, still awaits the invention of an instrument with which it can be as readily measured as light intensity. Attempts have been made to avoid the cleaning of lighting units only with questionable success. It should be realized that the maintenance of lighting systems is simple and relatively inexpensive and that it is the only means of insuring permanent satisfaction. — G. M. Fair.

Maintenance of Interior Lighting Systems. *Ward Harrison* and *J. R. Colville.* Electrical World, Jan. 24, 1920, 75, No. 4, 204–208. — Someone should always be responsible for cleaning lamps, reflectors, walls and ceilings. A case is cited where illumination was raised from 2.7 to 7 foot candles by simple expedients. Curves and tables showing the effect of dirt and dust upon the efficiency of the lighting equipment and indicating remedies are given. — G. M. Fair.

Sewage Filters from Refuse. *W. Scouller.* Public Works, Feb. 7, 1920, 48, No. 4, 81–82. — A bank of refuse, dumped as a fill in Chester, England, was leveled off and used as a sewage filter with such success that the corporation expects to extend the use of such material. Leek, England, has been practicing the same method for sixteen years. Results of chemical analyses of the crude sewage and the effluent are given. — G. M. Fair.

Prevention of Stream Pollution by Dye and Intermediate Wastes. *E. J. Casselman.* U. S. Pub. Health Ser., Pub. Health Rep., Jan. 23, 1920, 35, No. 4, 167–185. — The investigations which were the basis of this report were carried on for the most part at the plant of the Chemical Company of America at Springfield, N. J. Investigations were made "as to properties and disposal treatment of several wastes of the dye and intermediate industries. Laboratory studies were made of the properties of toluidine waste, nitrobenzene waste, monoethyl aniline waste, dye wastes, and lagoon liquor.

"Treatments that were successful on a 300-gallon scale and that were cheaper than evaporation were found for the lagoon liquor, the monoethyl aniline wastes, and the lake-forming dye wastes; and a method of treating toluidine waste was indicated in laboratory experiments.

"Specific treatments of wastes were recommended to the Chemical Company of America, based on their proposed production schedule." — L. A. Shaw.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Health Service — Hammermill Paper Company. *M. Harrison.* Mod. Med., June, 1919, 1, No. 2, 121–126. — A general statement of the manner of operation of the service department of the Hammermill Paper Company. The article contains one interesting figure

showing progressive accident reduction in 1916 to 1918 inclusive, incident upon the activities of the service department. — C. K. Drinker.

Health Supervision for Stockyard Workers at Armour and Company. Mod. Med., July, 1919, 1, No. 3, 209–212. — A very general statement of the work accomplished in this company. — C. K. Drinker.

Pay Gas Bills Here. *E. W. Hulet.* Factory, Feb. 15, 1920, 24, No. 3, 460–463. — This is a brief account of some of the service activities of the White Motor Company, written by the production manager. In connection with the medical service and related activities, it is pointed out that the cost per employee is relatively insignificant. " The cost per man per day for 1918, including the work of the Industrial Service Department, the cost of operating the factory hospital and the publishing of the White Book and the payment of the employees for time lost in jury service was a little less than 8 cents."

Every executive in the employ of the White Motor Company is invited to spend an hour a day in the gymnasium on company time. Not only is it felt that the physical returns warrant such a policy, but the opportunity to " play together " develops good fellowship and fosters a team spirit which is carried over into the work of the company. — C. H. Paull.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Old and New — Plans for the Reconstruction of French Villages. *Bruno Lasker.* Survey, Feb. 28, 1920, 43, No. 18, 643–646. — In commenting upon suggestions offered by Paul de Rutté, the writer points out that it is possible in reconstructing French houses to reconcile modern hygienic principles with traditional characteristics of building. Because of the scarcity of building materials, it will be particularly important for several years to use care in eliminating waste. Various regions will be expected to avail themselves of natural resources, so that timber regions may as far as possible build houses of wood, while other localities will use other materials to a larger extent. There will be a marked tendency toward standardization. Public building will play a greater part in community life, both architecturally and in the extent of service rendered. Mr. Rutté also favors the community house where social and cultural activities can be centered. — C. H. Paull.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Health Hazards and Afflictions of Soft Coal Miners. *Emery R. Hayhurst.* Mod. Med., June, 1919, 1, No. 2, 127–132. — This article presents data gained in a survey made during the summer of 1918. Forty-three mines employing 6072 men were visited in Ohio and fifty-six in Illinois employing 15,809 men. In addition, many mining towns were inspected and persons interviewed by a pre-arranged questionnaire, including twenty-three mining physicians in Ohio and fifty-three in Illinois. Mortality statistics were compiled principally from the records of the United Mine Workers of America at Springfield, Illinois.

A brief statement as to the character of the mines is followed by mention of the mine gases encountered in these two states. Methane is a frequent cause of explosions in Illinois and carbon monoxide is designated as troublesome in Ohio. " Many Ohio miners suffer from it because of the constant shooting which is allowed during working hours." Mine temperatures are constant, the variation in individual instances lying between 50°F. and 70°F. Humidity is high. An eight-hour day is universal, with very rare overtime. Absenteeism averages 10 per cent. per day, injuries causing 2 per cent. of the total absences.

The special health hazards of soft coal mining are listed but with the exception of dust — and no figures are given indicating either the amount of dust existing or the actual harm done by it — they are all simple instances of neglect of the principles of personal and group hygiene and are not directly attributable to mining. Poor water, lack of sewage disposal, inadequate wash and change houses — these are all matters of general hygienic interest which unfortunately attend other work than coal mining. The miner apparently suffers more from being a miner than he does from the specific job of getting out coal. — C. K. Drinker.

Protecting the Health of Soft Coal Miners by Prevention of Disease. *Emery R. Hayhurst.* Mod. Med., July, 1919, 1, No. 3, 216–220. — There is little reliable data as to disease among coal miners in Illinois and Ohio. Hayhurst summarizes his impressions gained from communication with physicians in the mining district as follows:

"There is no reason for believing that the usual afflictions, aside from the respiratory system and the musculo-osseous system, are more frequent among miners than among other employees. In fact, as a class, they are probably healthier than the average type of factory worker. Top workers, exposed to the weather, are said to have more sickness than those in the mine. Sickness is much more rampant among the women and children in mining districts than among the men. Alcoholism is far and away the chief bane. It is said to be on the decrease, explained by one physician as due to education, the increasing cost of alcoholic drinks, their frequent bad quality, and the extension of prohibition. Of the respiratory afflictions, chronic bronchitis associated with asthmatic symptoms, and often complicated by a chronic form of tuberculosis, is undoubtedly more prevalent than among agriculturists."

The health needs of soft coal miners are made clear in twelve recommendations with which the article closes.

" 1. There should be a housing survey.

" 2. There should be a medical service survey.

" 3. More aid should be extended to the respective state mining departments, particularly in the nature of hygienists' services.

" 4. There should be a standardization of the many existing forms of health insurance which now prevail.

" 5. All employees should be required to carry health insurance and optional membership done away with.

" 6. More Americanization is necessary in foreign districts.

" 7. More hospital, dispensary, nursing, and diagnostic services are required.

" 8. Physical examinations, preferably by state employment agencies, should be compulsory for employees at the time of hiring and after returning from an absence due to sickness or injury.

" 9. In any standardization of sickness insurance a free choice of physician should be allowed and remuneration placed on the merit basis, i. e., so much for a given service rendered. A large part of medical service could be fee-scheduled in much the same way as certain county medical societies at present publish their service rates.

" 10. Arrangements should be made for the services of specialists and experts, both for business management and for the insurance features, as well as for treatment services.

" 11. A certain part of all sickness insurance premiums paid should be definitely set aside to provide for the application of sanitary science, the latter to be under general supervision of the state health department.

" 12. All persons or services having to do with sanitation or medical care should be licensed as a check against unscientific methods." — C. K. Drinker.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Employment Management and Industrial Medicine. *Otto P. Geier.* Mod. Med., July, 1919, 1, No. 3, 213–215. — A plea for vigorous co-operation between employment manager and industrial physician to prosecute a successful campaign for health in industry. — C. K. Drinker.

The Need for an Examination of Certain Hypotheses in Mental Tests. *B. Ruml.* Journal of Philosophy, Psychology and Scientific Methods, Jan. 29, 1920, 17, No. 3, 57–61. — The author maintains that, relative to the time and number of people devoted to work with mental tests, the results have been astonishingly meager in theoretical value. As reasons for this, he points out several hypotheses which he thinks open to criticism, such as, that intelligence can be measured by a linear scale, that differences in intelligence will be paralleled by differences in test performance, and that the intelligence of an individual has a static level. — G. E. Partridge.

The New Psychological Tests. *E. L. Thorndike.* Educational Review, Feb., 1920,

59, No. 2, 97–104. — The relations of psychological tests to ordinary content examinations, as adapted to determining fitness to enter college, are discussed. The writer maintains that those who have made a thorough study of the facts are in agreement in believing that a well-designed battery of psychological tests ought to have a trial on even terms with the traditional entrance examinations. — G. E. Partridge.

MALINGERING

Malingering. *Judson C. Fisher.* Safety Engin., Dec., 1919, 38, No. 6, 342–344. — A system to lessen malingering could be used as follows: When an employee reports ill or injured, he has prompt attention by a doctor. A record of his history and disability together with his employment card are kept on file. These cards go to a doctor for comparison, and if the case is legitimate the treatment continues until disability ceases. If the case looks questionable, the social service department investigates it and takes action accordingly. Cases in which disability lasts over four weeks go to the chief surgeon, who makes an examination and report. The chief surgeon's word is final, and the man either goes to work or receives further treatment.

A firm hand by industrial boards in dealing with malingerers is essential. A group of expert diagnosticians would include a well-paid medical commissioner versed in industrial medicine and surgery and in the detection of malingering, and well-paid chief medical examiners. The expert should be acquainted with industrial conditions, should study the individual and know character, should have a fair knowledge of decisions of state boards and courts in various types of cases, and, finally, he should have a thorough knowledge of pathology.

In conclusion, it may be said that in attempting to recognize the disease, investigate the causes, and treat the condition, there is one point in view, namely, that of returning the sick or injured employees to work in the shortest possible time consistent with good recovery. This saves an economic loss to the employer and protects the honestly disabled employee who, by reason of his honesty, should profit in proportion as the malingerer should suffer. — R. Thomson.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

Employer not Liable for Negligence of Physician. Jour. Am. Med. Assn., Jan. 17, 1920, 74, No. 3, 198–199. (Richardson v. Greenburg (N. Y.), 176 N. Y. Supp. 651). — The following is quoted from the above journal:

"The Supreme Court of Arkansas affirms a judgment on a verdict directed in favor of the defendant in this case where the plaintiff alleged that while he was employed by the defendant he had his fingers crushed, and was directed to go to a physician employed by the defendant to treat its injured employees, and that this physician treated his injuries so carelessly and negligently that the amputation of all the fingers on the injured hand became necessary. The court says that the testimony in the case appeared to have been addressed to the proposition that the physician was negligent, and that the defendant was liable for this negligence because it directed the plaintiff to consult him. There was no intimation in the pleadings that the defendant was negligent in selecting a physician, nor was there any testimony to that effect unless it was by inference that the defendant was negligent through having employed a negligent physician. The court had a case, therefore, in which the pleadings and proof showed only that an injured employee was directed to, and placed in charge of, a physician who was guilty of negligence in his treatment of the case. But this allegation and this proof did not make a case for the jury. Where the employer owes his employee the duty of furnishing medical attention, or undertakes to discharge that duty, he does not become liable for the physician's negligence or lack of skill, but is liable only when he fails in the discharge of his duty to exercise ordinary care to select a physician possessing the requisite skill and learning and one who would give the patient the attention and treatment which the case requires."

Death from Glanders Contracted through Inhalation. Jour. Am. Med. Assn., Jan. 17, 1920, 74, No. 3, 198. (Richardson v. Greenburg (N. Y.), 176 N. Y. Supp. 651). — The following is quoted from the above journal:

"The Supreme Court of New York, Appellate Division, Third Department, holds, in answer to a question certified to it by the state industrial commission, that where an employee was required to lead a horse affected with glanders and during such time contracted the disease through inhalation of the bacteria, and died from the disease fourteen days thereafter, his death was not due to an accidental injury arising out of and in the course of his employment, within the meaning of the workmen's compensation law. The court says that compensation is payable by an employer only 'for the disability or death of his employee resulting from an accidental personal injury,' and that 'injury' and 'personal injury' are stated to 'mean only accidental injuries arising out of and in the course of employment, and such disease or infection as may naturally and unavoidably result therefrom.' The plain meaning of the words of the law, without the aid of judicial interpretation, induces the conclusion that the legislature intended to make compensatory no condition or death resulting from disease, unless the disease itself followed a traumatic injury or other injury not partaking of the nature of a disease. It is a matter of common knowledge that the conditions generally prevailing in cases of infectious disease are caused by poisons or toxins exuded by living organisms or bacteria present within the human body. Glanders cannot be differentiated from other diseases by the fact that ordinarily it is a disease which affects a horse rather than a human being, for it cannot matter whence the bacteria have proceeded which set up disease within the human body."

The Insurance Company in Industrial Hygiene. *A. D. Reiley.* Am. Jour. Pub. Health, Feb., 1920, 10, No. 2, 160–163. — Thus far insurance companies have not done nearly the amount of work in industrial hygiene that they have done in safety. During the past ten years the growing feeling that it is the duty of a life insurance company to cover by its protection as many lives as possible has induced the wiping out of many of the occupational restrictions, and a search on the part of the companies for material and data on which to base the rates charged for dangerous and unhealthy employment. These and other forces will eventually compel both the accident and workmen's compensation group of companies and the industrial and old-line life group to do more and more work in industrial hygiene.

From the industrial standpoint, there are two main methods of selecting a life-insurance risk — the individual and the class methods. In the latter the mortality experience of the industry is procured as nearly as possible from the whole country and a general rate imposed on the hazardous jobs. By the individual method some means are used for charging a different rate for selected risks, based on the intelligence of the worker and the general hygiene of the plant where he works, including dust and fume removal, accident protection, provisions for the protection, health and comfort of the worker, and minimization of special hazards. This plan has a great educational value with the worker and with the employer as well.

The recently developed plan of group insurance will, however, produce the most work and the greatest direct benefit to industry from the standpoint of industrial hygiene of all life-insurance efforts. This provides for the insurance by a plant of all its operatives without medical examination. This furnishes the opportunity and incentive for constructive work in studying and improving industrial conditions, the insurance company employing a group of skilled industrial men to study each problem presented and to work actively with the plant management in instituting improvements in safety and sanitation as a basis for reduction in the insurance rates for that plant. — Henry Field Smyth.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II — JUNE, 1920 — NUMBER 2

CONTENTS

GENERAL

PROGRESS TOWARDS PHYSICAL FITNESS IN THE UNITED STATES. *Jessie Payne.* The Child, Feb., 1920, 10, No. 5, 200–205. — A wave of interest in recreation and constructive physical training is passing over America. Indications of this are the National Physical Education Service established by the Playground and Recreation Association of America, and the introduction of compulsory physical training in fifteen states. The play movement grows rapidly. In some industrial cities where the community service is in operation — Chester, Bridgeport, Waterbury — men and women are turning in large numbers toward the recreational life. The impromptu playgrounds are increasing in popularity. The day is at hand when all states will pass adequate laws providing physical education for schoolchildren. — G. E. Partridge.

INDUSTRIAL HEALTH HAZARDS. *Charles A. Lauffer.* Safety Engin., Nov., 1919, 38, No. 5, 279–282. — The author sums up the hazards of employees as arising from:

1. Poisons, dust, fumes, gases.
2. Heat, humidity, ventilation.
3. Lighting.
4. Crowding.
5. Fire peril.
6. Association with diseased employees.

Employers' hazards are grouped as:

1. Decreased production; machines lie idle; sick employees are irregular, discouraged.
2. Excessive labor turnover, due to ill health,

unfitness for jobs assigned, prevalence of epidemic and infectious diseases.

3. Increased accident compensation expenditures, due to sickness masquerading as injuries. Cases arise daily where conditions are pathological, but trauma is alleged; or in which a minor trauma has provoked a long period of disability or an unusual degree of permanent impairment follows injuries, not in consequence of the gravity of the injury, but owing to intercurrent disease or the previously impaired vitality of the traumatized individual.

Among the remedies suggested for these health hazards are industrial health clinics, legalized releases for defects that cause abnormally long periods of accident disability, obligatory post-mortems, and federal health charts. — R. M. Thomson.

Labor Unions Help in Japanese Industrial Problems. *D. R. Simmons.* American Federationist, March, 1920, 27, No. 3, 344–345. — At present there exists but one labor union in the Japanese Empire, and this operates in but three cities. But these three cities — Kobe, Osaka and Kyota — contain nearly a fourth of all the laboring population of Japan. The very rapid increase in industrialism in Japan has introduced grave problems. Thirty years ago there were 125 factories, employing in all 15,000 people; now there are 25,000 industrial plants, and 2,000,000 employed. Thus far there is only one factory law applying to the employment of women and children, providing that children under 12 cannot be employed, and children under 15 and women cannot work more than twelve hours a day, and providing two holidays a month for this group. But for various reasons factories may be exempted under the law from fulfilling these regulations, so that the law as it stands is not effective. In general, there are bad working conditions, long hours, small wages and a pervading unhealthy atmosphere, tending to undermine the usefulness as well as the morals of the women workers. It is reported that in Tokyo, where industrial workers live in crowded districts, 66 per cent. of 1100 families live in single rooms averaging 9 by 9 feet in size. The cost of living has advanced 260 per cent. and there has not been a proportionate increase in wages. — G. E. Partridge.

International Labor Legislation. Bulletin of the International Labor Office, 1916, 11, Nos. 8, 9, 10. — These bulletins summarize laws and orders relating to labor in the United States, France, Germany, Great Britain and Ireland, British Colonies, Hungary, Netherlands, Norway, Sweden, and Switzerland. War emergency legislation — international, and in several of the belligerent countries — is also summarized. — G. E. Partridge.

Selling the Organization to the New Employee. National Association of Corporation Schools Bulletin, Jan., 1920, 7, No. 1, 19–25. — More and more industrial concerns are coming to feel that their own interests demand an introduction of the novice into the new and unfamiliar environment of the shop with as little friction as possible. Instructors are assigned to explain personally the new work to the men. Many firms publish booklets giving instructions. — G. E. Partridge.

Eastern Manufacturing Company Establishes a System of Proficiency Charts. National Association of Corporation Schools Bulletin, Jan., 1920, 7, No. 1, 39–42. — These charts give information expressed in terms of points and percentages. They show, in regard to individuals, quality of work, amount of production, lost time, etc. It is said that they are an aid in keeping men up to mark. — G. E. Partridge.

The Industrial Worker as a College Student: A Study of 86 Typical Cases at the Arts College of the Municipal University of Akron. *C. Bulger.* School and Society, Feb. 20, 1920, 11, No. 270, 265–270. — Every college has its group of self-supporting students, but the conditions and opportunities differ widely in different localities. Akron is a city of 200,000 people and is known as a rubber city though it has many kinds of industries. Recently adoption of a three-shift plan in some of the factories has proved favorable to working college students, since the second shift falls in the hours from 3 to 11 in the afternoon and evening. The article contains a table showing the standing of a group of entirely self-supporting students and another showing the standing of a group that is partially self-supporting. It is shown that in general the younger student tends to put the emphasis on the outside work rather than the college work, while the older student makes a better adjustment. The average grade of twenty-seven men entirely self-

supporting is 77.8, the passing mark at the university being 70. The average grade of all students of the university for a period of five years has been 77. The fifty-seven men included in the group of the practically self-supporting, however, show an average of only 70. The writer thinks the problem one deserving very careful investigation. — G. E. Partridge.

Technical Education and Citizenship. *B. W. Bond, Jr.* School and Society, March 6, 1920, 11, No. 271, 271–276. — The tendency away from the liberal studies and towards the technical, now so strong, has certain dangers and some consequences already evident. A serious defect of this prevailing technical education is the neglect of the historical subjects — branches which are necessary for the training of the citizen. This is showing already in our lack of broad leaders having a right appreciation of American ideals. — G. E. Partridge.

The Theory of the Vestibule and Up-grading School. *D. Snedden.* School and Society, March 6, 1920, 11, No. 271, 280–284. — Of 60,000,000 adult workers in the United States less than 2,000,000 (including home-makers) belong to the professions. There is, then, hardly more than a suggestion of adequate vocational training as systematized education for expert work. Recent experience has shown that training for industrial operations may be carried on in direct relation to productive work. The factory training school has been discovered to be an important educational institution serving the whole public. The vocational school located in the factory plant ought, then, to be maintained by public support. — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

MENTAL

The Movement for a Mental Hygiene of Industry. *E. E. Southard.* Ment. Hyg., Jan., 1920, 4, No. 1, 43–64. — This paper is a preliminary report of a research being conducted under the auspices of the Engineering Foundation of New York. It is an outline of a movement for the mental hygiene of industry. This movement is not new, for Southard quotes from papers published in 1917. He states that he wishes to speak primarily to the employment managers, and feels that he will be able to reach them because of the success of modern ideas in public health in general. What is now needed is the proper articulation into the public health movement of the mental hygiene movement.

The mental hygiene of industry may be divided into three main parts: (a) the psychology of industry, including mental tests for the hiring or the promotion of employees, and job analysis; (b) the psychiatry of industry, which is composed of such studies as fatigue, temperament, the effects of monotony, the problem of discharge of employees, grievances, labor turnover and the finding of jobs for the mentally subnormal and psychopathic; (c) psychiatric social work in industry. The problem here would be the tracking down of the causes of discharge of employees, grievances, dissatisfaction, and efficiency, and also the study of the effects of welfare work.

Southard also says that it was demonstrated at the Psychopathic Hospital that employment managers were not sufficiently trained to recognize individuals who would have been dangerous to hire. This was shown in a series of clinics for employment managers. These clinics proved so valuable that it is planned to arrange them on a permanent basis.

Examples are given of the good work of a psychiatric social worker, showing how employers can be induced to employ psychopathic individuals after the cases have been explained to them, and showing how well these individuals keep their jobs after the proper adjustments have been made.

The argument for a mental hygiene of industry may be put in the nutshell form as a question: "Why should not industrial managers seek the aid of (a) those who can measure at least a few of our mental capacities and have shown their abilities in war work, of (b) those who are the best specialists we yet have in temperament and the best experts in grievances yet developed, and of (c) others less professionally trained who are capable of tracing out or helping to trace out the actual situation of, per

example, labor 'turnover' as shown in the individual instance?" — S. Cobb.

Mental Hygiene a Public Health Activity. Editorial. Dementia Praecox Studies, Jan.–Apr., 1919, 2, No. 2, 62–63. — This editorial emphasizes the need of hygienic measures to control the production of mental diseases. The public is inclined to think of mental disease as a dispensation, and has little knowledge of the causes and of the early stages. The lowest estimate is that there are 4 feeble-minded and 2 insane per 1000 of population in this country. The first selective draft rejected 24 men per 1000 because of nervous or mental disorders. Of 84,000 in almshouses in 1910, at least 42,000 suffered from some form of mental alienation. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

The Removal of Carbon Monoxide from Air. *Arthur B. Lamb, William C. Bray*, and *J. C. W. Frazer*. Jour. Indust. and Chem. Engin., March, 1920, 12, No. 3, 213–221. — This article is a summary of the investigations on the removal of carbon monoxide from air carried on at the American University Experiment Station and at co-operating laboratories during 1917 and 1918.

The dangers of carbon monoxide in war and in peace and the difficulty of removing this gas from air are described, together with the requirements for a substance which can absorb the gas. The results obtained with a large number of absorbents are outlined and the advantages and disadvantages of each are considered. The group of absorbents which proved satisfactory was not discovered until 1918 when a catalytic mixture of metallic oxides, such as oxides of manganese, copper, cobalt, and silver, was employed with success. A mixture of this nature, called Hopcalite I., remained absorbent indefinitely against any concentration of carbon monoxide, provided the effluent air was adequately dried. The life of the canister containing the absorbent was therefore limited solely by the life of the drier. — G. M. Fair.

Gas Absorption by Charcoal. Engin., Feb. 20, 1920, 109, No. 2825, 250–251. — Observations on the selective absorption of gases by charcoal and upon the absorption of heat-treated charcoal. — G. M. Fair.

Felt Hat Making by the Acid-Nitrate-Mercury Method, and the No-Nitrate Method. *Christine Kefauver*. Month. Bull. N. Y. City Dept. Health, May, 1919, 9, No. 5, 127–128. — A description of the new no-nitrate method of preparing felt for hat making, discovered by William Braun. This eliminates the injurious effects of the old acid-nitrate-mercury method, in every process of which the workers were exposed to the fumes of mercury. In addition to the tremendous gain to the health of the workers, the saving in cost of production is said to be enormous. — L. A. Shaw.

Mercury Content of the Urine of Employees in a Chemical Industry. *H. Ilzhöfer*. Abstracted from Münch. med. Wchnschr., 1919, 66, pp. 14–15, and Zentr. Biochem. Biophys., 20. p. 508, by H. S. Paine in Chem. Abstr., Dec. 10, 1919, 13, No. 23, 3243. — "The Hg content of the urine of employees in a factory in which Hg and HgO were used in large amount was determined by the Buchtala electrolytic method. The analytical results are given in tabular form together with the clinical observations. There was no parallel variation between the excretion of Hg and the symptoms of poisoning. The Hg content of the urine increased, however, with the 'possibility of absorption' of Hg (comparison of employees working in portions of the factory in which varying amounts of Hg were vaporized)." — W. O. Fenn.

Report of Cases of Poisoning by Nitrobenzol. *Tuszewski*. Therap. d. Gegenw., Sept., 1919, 60, No. 9, 326–329. — A small bottle of nitrobenzol ($C_6H_5NO_2$) was sold to a workman in the city of Berlin, supposedly as benzaldehyde (C_6H_5CHO), a widely used flavoring extract. He and two of his children were severely poisoned after the ingestion of from 1–2 c. c. of the liquid. The father, a man of 40 in good physical condition, was only mildly ill. On awakening shortly after midnight, having taken a cubic centimeter or less of the fluid at the evening meal, he found himself dizzy and mentally confused. He was obliged to remain in bed for several days in a

weak and drowsy condition. Objectively his skin was pale, lips cyanotic, and blood pressure low. The urine remained normal.

The son, aged 13, in good health, partook of the poison before retiring and was found in a stuporous condition by his parents at half-past twelve. He was transferred to the hospital the next morning, where he gradually regained consciousness under constant inhalation of oxygen and the infusion of physiological salt solution. His skin was pallid, hands and lips bluish-black, lungs and heart negative, radial pulse rapid and hardly palpable. The blood pressure was 95/65 mm. Hg. A reddish urine was passed which was negative for albumin, sugar, bilirubin, urobilin, urobilinogen and hematoporphyrin. Indican was found increased. The following day a subicteric tint of the skin was noted and a left-sided facial paralysis developed. The spleen was easily palpable; leucocyte count 9700; hemoglobin 53 per cent.; blood pressure 83/43 mm. Hg; temperature 38°C.; pulse 70–80. His condition slowly improved and five days later the icteric tint had faded, the spleen was no longer palpable, and the facial paralysis had disappeared. At this time the blood pressure had risen to 95/30 mm. Hg, the hemoglobin to 55 per cent. The red count was 3,200,000, the leucocyte count 9400. A differential count showed 11 per cent. myelocytes and 3 per cent. Turk irritation forms. Poikilocytosis and anisocytosis as well as chromatophilia were noted. The urine was negative for albumin, sugar, bilirubin, and hematoporphyrin. Tests for urobilin and urobilinogen were positive. Two weeks later the patient was discharged, and at that time the leucocyte count was 9000, the erythrocyte count 3,900,000, the hemoglobin reading 68 per cent. The blood pressure had risen to 96/45.

A daughter, a well-developed girl of 16, was similarly poisoned and taken in an unconscious condition to the hospital, where the same therapeutic measures were immediately resorted to. Venesection was unsuccessfully attempted and scarcely any blood could be obtained, until finally the radial artery was severed. The patient did not regain consciousness, and after a series of clonic convulsions died twenty-two hours after taking the poison. An autopsy was not performed until six days after death, when nothing of importance aside from post-mortem changes was noted. Tests for nitrobenzol in the blood and urine were positive.

The writer calls attention in these three cases to the injurious effect of nitrobenzol upon the vasomotor center as evidenced by the pallor of the skin, the cyanosis of face and hands, and the low blood pressure. — G. B. Wislocki.

Dinitrobenzol Poisoning. *A. H. Hübner.* Deutsch. med. Wchnschr., Nov. 13, 1919, 45, No. 46, 1273. — The author reports on the condition of five patients about a year after they had left the dinitrobenzol factory. Breathlessness, palpitation, pains in the joints, and headaches disappeared in the course of a few weeks. The easy fatigue, loss of energy, listlessness, and irritability persisted somewhat longer. The gross disorders of sight, hearing, and sensation disappeared only exceptionally. The optic atrophy and central deafness persisted, as did the absence of certain reflexes. Otherwise, the physical examination was negative. Only one of the five considered himself well.

The author believes that dinitrobenzol is especially harmful to women, producing menstrual disorders and sometimes abortion.

A case of alleged criminal poisoning by dinitrobenzol is cited, with autopsy findings. — T. J. Putnam.

Hazards of the Dye Industry. *A. K. Smith.* Am. Jour. Pub. Health, March, 1920, 10, No. 3, 255–257. — This paper is a brief report of conditions met with in the dye industry as conducted by the E. I. du Pont de Nemours Co. The hazards discussed are the accidental burns from mixed acid, accidental escape of nitrous fumes and poisoning by inhalation or skin absorption of nitro and amido compounds of the hydrocarbon compounds of the benzene series. In many cases it is difficult to ascribe the poisoning to any particular chemical, and the credit is given to the main product of the factory area where the case occurred. Special reference is made to skin irritation produced in susceptible individuals handling these compounds and it is stated that habitual drinkers of alcoholic liquor are especially liable to these skin inflammations. Periodic blood examinations on many thousand cases show no marked changes of any kind except for the decreased hemoglobin and the formation of methemoglobin in acute cases. No fatalities from anilin or its allied compounds have been noted and no definite chronic poisoning has been produced.

Properly equipped buildings, well ventilated, and constant improvement in methods of production and handling, together with proper

selection and care of the workmen, will reduce the hazards in the dye industry to those of any other industry. — H. F. Smyth.

Wood Alcohol Poisoning. *R. P. Albaugh.* Mod. Med., Aug., 1919, 1, No. 4, 300. — A very brief statement giving the general effects of wood alcohol. There is no direct data upon industrial poisoning. — C. K. Drinker.

Mustard-Gas Poisoning. *C. M. Wilson* and *J. M. Mackintosh.* Quart. Jour. Med., Jan., 1920, 13, No. 50, 201–240. — The authors analyzed a series of 1500 mustard-gas casualties. It was estimated that a functional neurosis was recognized in 22 per cent. of all admissions in the mustard gas group. The incidence of the commoner neuroses was: functional photophobia, 12.6 per cent.; functional aphonia, 7.2 per cent.; functional vomiting, 1 per cent.; effort syndrome, 1.2 per cent. These functional disorders appear to arise in many cases from slight initial organic lesions. From the point of view of organic effects on the respiratory tract, all degrees of laryngitis were encountered, from slight cases with hoarseness and painful cough to a grave condition associated with the formation of a false membrane. Infection seemed to follow very frequently on the destruction of epithelium in the trachea and bronchi, soon after which signs of bronchitis and pneumonia often appeared. Out of 692 cases admitted to the hospital in four months, 14 per cent. developed a severe bronchitis or bronchopneumonia. The distinction between bronchitis and bronchopneumonia in gas poisoning is artificial. In twenty-two necropsies, consolidation was absent in four, lung abscess was found only four times, and gangrene of the lung only once. Bronchiectasis was a rare event in cases that recovered; it was present in 1 per cent. of all cases admitted. The eyes were affected in 74.6 per cent. of the cases. Involvement of the gastro-intestinal tract was unusual. Vomiting after the first day was also unusual. Out of eight cases in which vomiting was prolonged, six were extensively burned. The blood only showed a leucocytosis which was in no way peculiar to the bronchopneumonia following gas poisoning. Femoral thrombosis occurred in two cases. The results of blood pressure readings were largely negative. Contrary to the French view, kidney involvement was rare in the absence of extensive burns. Burns beyond a mere erythema were present in 31 per cent. of all cases. The incidence of influenza and common colds was no commoner in gas wards than in the other medical wards. In a small epidemic of diphtheria, the incidence of carriers among the convalescents from gassing was much higher than among other convalescents. The mortality of mustard gas poisoning was about 2 per cent.; 87 per cent. of all cases which arrived at the base hospital were able to march again within a month.

Concerning the pulmonary sequelae of mustard gas poisoning it is observed that in some men, previously healthy, it induces a condition of chronic bronchitis, pulmonary fibrosis, and rarely phthisis. It is not possible to say that the slight evidence of emphysema found in a few cases was not present before gassing. — H. A. Bulger.

Chromate Poisoning. I. Skin Lesions. *Urban;* II. Eye Changes. *C. Colden;* III. Pathological Anatomy. *R. Hanser;* IV. Clinical Aspects of Chromate Poisoning. *Forschbach.* From the Dermatological Division of the Allerheiligen Hospital in Breslau. Original in Berl. klin. Wchnschr., 1919, p. 363. Following is a translation of the abstract in Therap. Monatsh., Aug., 1919, 33, No. 8, 319. — " In the preparation of an antiscabetic salve a salt of chromic acid, probably potassium chlorate, was accidentally used in place of the sulphur. A number of patients were severely poisoned and twelve of them died. The constitutional effect was greatest in those patients suffering from scabies, whose skin was much excoriated. The effect upon the skin consisted of a strong burning sensation and the appearance of areas of necrosis which became confluent and progressively deeper. — The ocular lesions were neither extensive nor severe. In four out of thirty-one patients vascular changes in the retina were noted, in two pallor of the optic disks, in one anisocoria, in one retinal ecchymosis. — Description of the pathological anatomical findings. — Clinically, the condition presented a picture of extreme renal insufficiency with scant albumin and few cells. A gradual change from oliguria to polyuria occurred, but in some the renal function remained greatly impaired, manifested in an inability of the kidneys to concentrate the urine. The blood changes were noteworthy, consisting principally in bone marrow stimulation. — Therapeutic measures were of no avail in the severe cases." — G. B. Wislocki.

DUST HAZARDS AND THEIR EFFECTS

Elimination of Dust Hazard at Niagara Falls Plant. Chem. and Metall. Engin., Feb. 25, 1920, 22, No. 8, 348. — A survey of the chemical and metallurgical plants at Niagara Falls by the United States Public Health Service has led to the installation of means for the removing of dust from factory air and for minimizing hazards from fumes and poisonous gases. — G. M. Fair.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Non-Specific Immunity. *Victor C. Vaughan* and *G. T. Palmer.* Mil. Surgeon, Jan., 1920, 46, No. 1, 1–8. — An explanation is offered of the fact that, when armies are recruited and men crowded together, those from areas sparsely populated and unaccustomed to the crowd life are more susceptible to infection, and that seasoned soldiers bear even newly imported infections better than do fresh recruits. The authors believe that this increased resistance to infection is similar to that displayed by animals after injections of protein poisons, and they ascribe it to the difference in the amount of bacteria and other proteins absorbed by the lungs. — H. A. Bulger.

Statistics of the 1918 Epidemic of Influenza in Connecticut. *C.-E. A. Winslow* and *J. F. Rogers.* Jour. Infect. Dis., March, 1920, 26, No. 3, 185–216. — The rapid spread of influenza and the fact that rigidly maintained quarantine completely protected isolated groups of individuals from contracting the disease, indicate clearly that it was transmitted by human contact, supplemented in certain cases, perhaps, by the use of infected food and utensils. The mortality was proportionately higher among males than among females, and proportionately very much higher in individuals under 5 years of age and in those from 20 to 40 than at other periods of life. It seems doubtful that the lower mortality in later life can be attributed to immunity acquired in the 1892 epidemic, since immunity due to this cause would have been evident in the age period from 30 to 40 years which, in fact, showed about the same rate as the age period 20 to 30. Native Irish, English, and Germans showed a relatively low mortality; Canadians, Russians, Austrians, and Poles showed a relatively high rate; Italians, an exceedingly high rate. The mortality was lower in rural than in urban communities, lower in agricultural than in manufacturing communities, and very low in a group of small towns remote from any railroads. In general, mortality was highest in those communities which were affected earliest. No evidence was found that variations in administrative procedure, such as the closing of schools, exerted any influence on the spread or the severity of the disease. — H. A. Bulger.

Mumps: A Review of our Knowledge Concerning its Etiology, Mode of Transmission, Incubation, and Period of Infectivity. *Conrad Wesselhoeft.* Mil. Surgeon, Jan., 1920, 46, No. 1, 63–82. — The causative factor of mumps is still undetermined. It has been shown that a filterable virus in the saliva (which is sterile by the ordinary aërobic and anaërobic methods) will cause a parotitis in cats. The blood serum contains the exciting element, thus explaining the manner in which many of the complications are brought about. The mode of transmission is by direct and indirect contact. Infection by fomites seems possible. There is no record of epidemics traced to water or milk supply, but food has been considered by some as a possible source of infection. The incubation period of mumps is still unsettled. When contacts are isolated this should be for from fourteen to twenty-four days after exposure. The period of infectivity is unsettled. The general trend is to be guided by the duration of symptoms. An extensive bibliography is given. — H. A. Bulger.

Investigations on the Etiology and Clinical Picture of Epidemic Jaundice. *Julius Hatiegan.* Wien. klin. Wchnschr., Sept. 25, 1919, 32, No. 39, 956. — The author studied catarrhal icterus of epidemic variety and concludes that this is an acute infection and intoxication confined to the liver. It is associated with mild pathological change in the bile capil-

laries and degenerative changes in the liver cells. The etiological agent is apparently a member of the colon group of organisms and possesses marked motility. — Barnett Cohen.

The Diagnosis of Chronic Glanders. *Albert W. Bauer.* Wien. klin. Wchnschr., Nov. 20, 1919, 32, No. 47, 1134. — Chronic glanders is to be suspected in cases presenting multiple periarticular and muscular abscesses associated with high, septic temperatures when the focus and etiology of the pyemia are obscure and the occupation of the patient suggests a possibility for glanders infection. Support for this may be found in the discrepancy between the good subjective state of the patient and his marked septic condition, as well as in the relative reduction in pulse rate. Even if the bacteriological examination of the pus fails, serologic tests on the blood (agglutination and complement fixation) will establish the diagnosis. — Barnett Cohen.

Disinfection Methods against Trychophyte Infection (Sycosis Barbi) in Barber Shops. *Wolfgang Löwenfeld.* Wien. klin. Wchnschr., Sept. 18, 1919, 32, No. 38, 941. — Mechanical cleansing must always stand as the first effective instrument against the spread of this ring-worm infection. Water at 100°C or 10 per cent. soda solution at 80°C killed the organism and its spores within five minutes. Alcohol, 80 per cent., or phenol, 2.5 per cent., sometimes failed to sterilize within thirty minutes. Formalin, 2 per cent., was very effective in thirty minutes. — Barnett Cohen.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Miners' Nystagmus. *T. Lister Llewellyn.* Abstract of a paper read before the Institute of Mining Engineers (Great Britain), Jan. 12, 1920. — The first case of miners' nystagmus was described by Decondé in 1861, and it was not until after the compulsory introduction of the safety lamp in 1876 that an increase in the number of cases began to attract general notice.

The cause of this disease is now usually considered attributable to the inefficient lighting system in use in the safety lamp coal pit, as it is rare in the naked light districts. Dr. Llewellyn states that there are two varieties of nystagmus: (1) latent, (2) manifest. The symptoms include failure of sight, dazzling effect of lamps, giddiness, headache, etc. Serious as this disease is when looked at from the point of view of the individual sufferer, its importance to the industry as a whole must be taken into consideration.

Dr. Llewellyn estimates the cost of the disease to the nation to have been over £100,000 in 1910. At present day prices it is computed at over a million sterling per annum. Moreover, the miner suffering from nystagmus may be a source of direct danger to himself and others owing to his failure to detect the presence of gas. Of 49 normal men examined for the detection of the firedamp cap, 21 gave an incorrect result; while of 41 nystagmus cases, 37 gave an incorrect, and only 4, a correct result.

Dr. Llewellyn thinks that the illumination at present found in the open light pits should be taken as a standard. This means, as he points out, a fivefold increase in the illumination now obtaining in the safety lamp pits. Even with this increased illumination, the author does not think the disease will be completely eradicated and, as he is careful to point out, the full benefit will not be reached for some years.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Safety Movement in England. U. S. Bur. Labor Statis., Month. Labor Rev., Dec., 1919, 9, No. 6, 302–304. — Reference is made to an article by Mr. Gerald Bellhouse entitled *Accident Prevention and Safety First,* which appeared in the Annual Report of the Chief Inspector of Factories and Workshops of Great Britain for 1918. Up to the onset of the war, England relied chiefly on factory inspection to reduce the number of industrial accidents. The year 1917, however, marked the establishment of the British Industrial Safety First Association. The various improvements made in English plants through the efforts of the association are considered in the report. It is interesting to note how similar British practice is to our own.

Unfortunately, however, the lack of statistical information makes it impossible to say how Great Britain's accident rate compares with that of the United States. — R. B. Crain.

Fundamental Principles of Safeguarding. *Sidney J. Williams.* Safety Engin., Oct., 1919, 38, No. 4, 217–219. — The author treats this problem under two headings: *What Shall I Guard?* and *How Shall I Guard It?* The answer to the first question is briefly that if a plant is to be 100 per cent. safe, it is necessary to guard every moving part wherever located. If a moving part is in a place "where nobody ever goes," it should be remembered that someone is likely to go sooner or later for some reason which cannot be anticipated. The second half of the subject includes general suggestions in regard to safeguards and their application to specific cases, such as guards for gears, bolts, flywheels, shafting, etc. — R. M. Thomson.

Is Industrial Death Necessary? *Lucian W. Chaney.* Safety Engin., Oct., 1919, 38, No. 4, 196–198. — A negative answer to this question is greatly to be desired. If such an answer is ever to be obtained, it will be because the safety men of the country have faith in its possibility, and energy according to their faith. In 1907 the severity for the iron and steel industry was not less than 21.6 days per worker; in 1913, 13.9 days; in 1917, 12.2 days. A preliminary figure for 1918 shows 10.9 days. In his experience with the industrial accident problem, the author has become convinced of two things: (1) that the accepted method of estimating industrial hazard by means of frequency rate is wholly inadequate; (2) that the factor of personal carelessness is being overstressed very greatly. The following conclusions are given:

1. The general frequency rate is an index of the prevalence and fluctuation of minor injury. The reduction of this type of injury depends on an educational program, the final effect of which is to cause the men to do their work in a safer manner. A rising frequency rate may indicate one or all of three conditions: (a) no educational program or a poor one; (b) a good program administered with poor judgment or with insufficient vigor; (c) industrial conditions which might for a time overbalance any program however good.

2. The general severity rate is an index of conditions in regard to death and major injury. The reduction of this type of injury depends in very large measure upon the procedures included in the expression "engineering revision." When the severity rate rises there should be immediately a very searching inquiry for possible imperfection in the engineering program. — R. M. Thomson.

When Machinery Must be Guarded. *Chesla C. Sherlock.* Machinery, Jan., 1920, 26, No. 5, 450–451. — Employers must be guided more or less by decisions handed down by the courts in the matter of guarding machinery, as it is evident that all machinery, tools and appliances are not dangerous within the meaning of the law, nor are all dangerous agencies employed in the average shop machines or appliances within the meaning of the law. The safeguards required are not necessarily the best or latest on the market but of such a kind as reasonably prudent men employ in a particular industry. A law is considered notice to everyone the minute it is written into the statute books and employers must, therefore, be familiar with the requirements. It is not the intention of the statutes to interfere with the practical operation of machinery. In fact, it is held in a number of states that the safety appliance act is inapplicable when the measures necessary to safeguard the machine are such that they destroy its value. The following conditions are given as those under which employers must guard machinery:

"1. When it is expressly required by the statute; that is, when certain kinds of machinery are named in the statute itself.

"2. When this machinery is dangerous to the life and limb of a workman under normal and careful operation; or where it is plainly evident that the machine should have been included in the enumerated list of the statute, but was apparently overlooked. Where there is no list given in the statute, the employer can only have discharged his duty when he has safeguarded all dangerous machines or appliances as a reasonably cautious man in the same profession, trade or calling would have done." — R. M. Thomson.

Safety Education in Textile Industry. *William S. Ide.* Safety Engin., Nov., 1919, 38, No. 5, 284–285. — A brief outline of how safety education is applied at the mills of S. Slater & Sons, Inc. The cost of accidents to the corporation as well as to the injured is impressed

upon the employees by posting each week a report of accidents and their costs. Safety work by the overseer of a department is just as much a part of his job as production. — R. M. Thomson.

Preventing Accidents in the Shop. *J. E. Bullard.* Am. Machinist, March 4, 1920, 52, No. 10, 503–504. — Accident prevention is as much a matter of education as of safeguards. Some hints are given as to the type of clothing which should be worn in machine shops. — G. M. Fair.

Coke-Oven Accidents in the United States during the Year 1918. U. S. Bur. Labor Statis., Month. Labor Rev., Dec., 1919, 9, No. 6, 299–302. — With the development of the by-product process, accident rates, high from the beginning, have shown a steady tendency to increase. A study of mortality statistics compiled by the Bureau of Mines and the Bureau of Labor Statistics definitely shows this. As regards the cause of the increase, inspection of the tables shown leads one to infer that:

1. It seems probable that the disturbed situation of the working force, characteristic of war years, is mainly responsible. It is also suggested that the influenza epidemic in the latter part of 1918 may have affected the accident rate.

2. In both beehive and by-product ovens the prolific cause of fatal injury is the transportation system. Of the rate in 1918 of 2.84 per 1000, 1.36 cases are credited to various elements of the transportation. This hazard has been found everywhere a difficult one with which to deal. — R. B. Crain.

Explosion Hazard in Steel Mills from Partly Consumed Coal Dust. Chem. and Metall. Engin., March 3, 1920, 22, No. 9, 422–423. — This review of the *Monthly Reports of Investigations* of the Bureau of Mines for December, 1919, deals with a study of the hazard introduced into steel mills by the substitution of powdered coal for natural gas in the heating furnaces. Conditions leading to explosions and fires are explained and precautions which may be taken for their prevention are discussed. — G. M. Fair.

Dangers in the Dyestuff Industry. *L. C. Cone.* Safety Engin., Nov., 1919, 38, No. 5, 282–284. — An article dealing with the risks of explosions about dyestuff plants. With the growth of the American chemical industry the explosion hazard will become greater and greater, and if the industry is to be permanently successful, it must not permit itself to be restrained because of explosion risks. By successful co-operation between the safety engineer and the technical men of his organization, it will be possible gradually to eliminate the explosion risks of this industry. — R. M. Thomson.

Dangers in the Dyestuff Industry. *L. C. Cone.* Chem. and Metall. Engin., Jan. 7, 1920, 22, No. 1, 33–35. — A review of incidental accidents due to inexperience in new industries, with special reference to the dyestuff industry. Explosion risks of dyes and intermediates, of high-pressure apparatus, and of inflammable vapor mixtures are discussed. — G. M. Fair.

Preventing Accidents in Gas Plants. *J. F. Conner.* Chem. and Metall. Engin., March 3, 1920, 22, No. 9, 421. — This paper, read before the Eighth Annual Safety Congress of the National Safety Council, deals with the inherent hazards of the industry, the precautions against dust explosions, the use of respirators for emergency work, and methods of preventing accidents, especially from the point of view of educational propaganda. — G. M. Fair.

The Personal Element in a Safety Program for the Foundry. *M. F. Gartland.* Chem. and Metall. Engin., Feb. 18, 1920, 22, No. 7, 323–325. — Abstract of paper read at the Eighth Annual Safety Congress of the National Safety Council, Cleveland, Ohio, Oct., 1919. — G. M. Fair.

Application of Sand Blast to General Foundry Work — II. *H. D. Gates.* Am. Machinist, Jan. 8, 1920, 52, No. 2, 73–76. — Ample protection for operators should stand foremost in the minds of the designers of sandblast equipment. This is accomplished to some extent by providing mechanical means of handling material, with accompanying savings in labor cost and time. — G. M. Fair.

Safety Features of British Switchgear. *B. E. Mittell.* Electrical World, Feb. 7, 1920, 75, No. 6, 309–312. — Progress has been made

in England toward protecting operators from shock in switch-board manipulations. Three types of switchgear in common use are described in detail to show how the safety of operators is effected. — G. M. Fair.

Emergency Fire Protection Connections to Municipal Water Systems at Hartford, Conn. Jour. Am. Waterworks Assn., March, 1920, 7, No. 2, 221–222. — A memorandum on experiences with check valves at Hartford, Conn. — G. M. Fair.

Water Works for Fire Protection. *H. F. Blomquist.* Jour. Am. Waterworks Assn., March, 1920, 7, No. 2, 223–231. — This paper discusses the principles of design of water works for fire protection service and the value of such service, together with methods used by various municipalities in paying for it. — G. M. Fair.

Grounding and Polarization as Protecting Measures: Part I. *W. J. Canada.* Electrical Rev. (Chicago), Feb. 28, 1920, 76, No. 9, 351–354. — A discussion of the reasons and methods for grounding certain electrical circuits in order to afford adequate protection against fire and life hazard. — G. M. Fair.

INDUSTRIAL SURGERY

The Importance of Physical Therapy in Military and Civil Practice. *William S. Bainbridge.* Mil. Surgeon, Dec., 1919, 45, No. 6, 663–678. — The war having shown us that the majority of disabled men can be retrained and re-educated, we must now apply the lesson to civil life. That industry takes a heavy toll yearly is nowhere so evident as in the United States. Physical methods are of the greatest importance in securing and maintaining general health, and will render a large percentage of the unfit able to endure prolonged exertion. It is suggested that facilities should be afforded at medical schools and hospitals for medical men and medical students to become instructed in the science and practice of physical therapy, treatment by which is effective in many functional disorders and in some diseases. — H. A. Bulger.

The Paraffin-Wax Treatment of Burns, with Special Reference to Mustard-Gas Burns. *James S. Taylor.* Mil. Surgeon, Jan., 1920, 46, No. 1, 83–93. — Taylor concludes that all burns become infected although they may be sterile at the time of receipt, that the Carrel technique of handling burns is superior to any other method, and that the paraffin-wax treatment has proved its worth in every particular, both from the point of view of the surgeon and from that of the patient, in that with its use the time of disability is shortened, suffering is lessened, and deformities and contracting cicatrices are prevented. — H. A. Bulger.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Activity and Rest in Animals and in Man. *J. S. Szymanski.* Ztschr. f. allg. Physiol., 1919, 18, No. 2, 105–162. — This is an interesting and important study of activity in various animals and in the human infant. The experiments were made with the "Aktograph," several modifications of which were devised by the writer. The apparatus was arranged to record intensity and frequency of motion during a continuous period of twenty-four hours. Special investigations were made on the influence of sunlight upon activity and on the depth of sleep. The paper seems to have most value as a study in method of experimentation. — G. E. Partridge.

Fitness and Breathing during Exertion. *Henry Briggs.* Jour. Physiol. (Proc. Physiol. Soc.), Sept. 5, 1919, 53, Nos. 1 and 2, xxxviii–xl. — A comparison is made between the respiration of a trained and a sedentary subject doing measured work upon a bicycle ergometer. The trained man breathes much less air for the same accomplishment. He uses slightly less oxygen. The percentage of CO_2 in his expired air is roughly six against four for the

untrained subject with his less economical mode of breathing. Air enriched with oxygen is more helpful to the sedentary than to the athletic individual. — P. G. Stiles.

An Examination of the Mechanical Efficiency of a Healthy Adult by his CO_2 Discharge. *A. D. Waller* and *G. De Decker*. Jour. Physiol. (Proc. Physiol. Soc.), Sept. 5, 1919, 53, Nos. 1 and 2, xxx-xxxi. — The efficiency is figured first for the bicycle ergometer and second for stair-climbing. With the bicycle the net efficiency ranges from 20.8 to 26.8 per cent., increasing with the rate of performance. For stair-climbing (5 ascents of 20 metres) it reaches 32 per cent. — P. G. Stiles.

The Physiological Cost of Marching Measured by CO_2. *A. D. Waller*. Jour. Physiol. (Proc. Physiol. Soc.), Sept. 5, 1919, 53, Nos. 1 and 2, xxiv–xxvi. — The evolution of CO_2 by two soldiers moving round a track is about as follows: marking time, 16 c. c. per second; marching 3.4 miles per hour, 16 c. c. per second; 3.9 miles per hour, 22 c. c. per second; 5.9 miles per hour (double time), 35 c. c. per second; 7.2 miles per hour, 57 c. c. per second. The resting figure is 5 c. c. per second. — P. G. Stiles.

The Physiological Cost of Tailor's Work Measured by CO_2 and Expressed in Calories. *A. D. Waller* and *G. De Decker*. Jour. Physiol. (Proc. Physiol. Soc.), Feb. 20, 1920, 53, No. 5, lxxiii–lxxiv. — The metabolism of men and women engaged in the tailor's trade has been measured by the use of portable bags to collect the expired air. The average cost above the basal level is given as 463 Calories for an eight-hour day. This is less than one-fifth the figure previously obtained for a dock laborer. — P. G. Stiles.

Energy Loss of Young Women in Light Household Work. *F. G. Benedict* and *Alice Johnson*. Proc. Am. Phil. Soc., 1919, 58, 89–96. Abstracted as follows in Physiol. Abstr., Jan., 1920, 4, No. 10, 454. — "The average of 23 calorimeter experiments gave the resting metabolism as 1.12 cal. per kilo per hour. The increases over this by standing up, reading aloud, sewing, singing, dusting, sweeping, etc., are given in detail; they vary from 1 to 150 per cent., the increase being proportional to the labour involved." — McKeen Cattell.

The Influence of Alcohol on Manual Work and Neuro-Muscular Co-ordination. *H. M. Vernon*. Medical Research Committee Special Report Series, No. 34, 1919. Abstracted by J. C. D. as follows in Physiol. Abstr., Oct., and Nov., 1919, 4, Nos. 7 and 8, 341. — "The influence of alcohol on manual work and on neuro-muscular co-ordination was investigated in 8 men and 5 women. The number of mistakes in a typewriting test was increased after the alcohol. The degree of effect depended largely on whether the alcohol was taken on an empty stomach or with food. Similar results are recorded in target-pricking tests. Experiments with claret and with pure alcohol of equal alcoholic strength showed that claret was slightly the more toxic." — McKeen Cattell.

The Efficacy of Thoroughly Drying Clothes. *Leonard Hill* and *D. H. Ash*. Jour. Physiol. (Proc. Physiol. Soc.), Feb. 20, 1920, 53, No. 5, lxxi–lxxii. — Dried fabrics of many kinds show a marked rise of temperature (4–6°C) when they are plunged into water or saturated air. Thus the cooling effect of perspiration may be exchanged for a warming effect when the skin comes in contact with dry garments or blankets. — P. G. Stiles.

Output of Women Workers in Relation to Hours of Work in Shellmaking. *Ethel E. Osborne*. A Study of Improved Methods in an Iron Foundry. *C. S. Myers*. Reports Nos. 2 and 3 of the Industrial Fatigue Research Board (Medical Research Committee). H. M. Stationery Office, 1919. Abstracted by W. D. H. as follows in Physiol. Abstr., Oct., and Nov., 1919, 4, Nos. 7 and 8, 302. — "Both of these valuable reports, so opportune at the present time, coincide in recording that lessened hours of work means increase of output. The absence of undue fatigue is the great factor in this result." — McKeen Cattell.

Fatigue Research in Tinplate Manufacture. Chem. and Metall. Engin., Feb. 4, 1920, 22, No. 5, 223–225. — Abstracts from the *Iron and Coal Trades Review*, Sept. 12, 1919, p. 336. This article, which contains a report on the operations connected with the manufacture of tinplate in South Wales, was abstracted from *Engineering*, Vol. 108, No. 2806, p. 484, in a previous issue of the Journal of Industrial Hygiene (1919–1920, Vol. 1, p. 149). — G. M. Fair.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Experiments on Acclimatisation to Reduced Atmospheric Pressure. *J. S. Haldane, A. M. Kellas,* and *E. L. Kennaway.* Jour. Physiol., Dec. 3, 1919, 53, Nos. 3 and 4, 181–206. — The observers, who were also the subjects of these trials, experienced the effects of rarefied atmospheres in a steel chamber. The barometric pressure was reduced to correspond with various altitudes, on one occasion to 295 mm. Hg which is equivalent to 26,500 feet. This was near the limit of endurance as shown especially by mental lapses. On four successive days two of the investigators remained eight hours in the chamber, each day under a lower pressure than before. Some acclimatisation was certainly secured. This was demonstrated by increasing power to sustain exercise. It was correlated with a diminution of urinary acid and ammonia. This points to a lowering of blood alkali to keep pace with the concurrent lowering of CO_2. The chief factor in acclimatisation is believed to be a secretory power acquired by the pulmonary epithelium. — P. G. Stiles.

Acclimatisation to Low Atmospheric Pressures. *J. S. Haldane, A. M. Kellas,* and *E. L. Kennaway.* Jour. Physiol. (Proc. Physiol. Soc.), 1919, 53, xlvi–xlvii. Abstracted by W. D. H. as follows in Physiol. Abstr., Oct., and Nov., 1919, 4, Nos. 7 and 8, 322. — "Experiments in a steel chamber caused partial acclimatisation, attributed to increased secretory activity of the alveolar epithelium. Increased breathing due to anoxemia produces an alkalosis. The supposed acidosis at great altitudes is only the compensation for the alkalosis. This requires time, and disappears at normal pressure, so exposure to a low pressure for some hours per diem is only partially effective in producing acclimatisation. Mere increase of breathing or of the circulation is ineffective in relieving anoxemia unless the alkalosis is relieved also, for the alkalosis lessens the dissociation of HbO in the capillaries, and thus neutralises any relief which would otherwise be produced." — McKeen Cattell.

HEAT, COLD AND HUMIDITY

The Optimum Humidity for Mental Work. *W. H. Burnham.* The Pedagogical Seminary, Dec., 1919, 26, No. 4, 311–329. — There is a wide range of opinion about the importance of humidity, some thinking that humidity has no effect upon health, others that it is a very important factor. The problems of temperature and of humidity are inseparable, and we have to deal not only with absolute humidity, but with relative humidity — that is, the relation of absolute humidity to the possible humidity. A study of the available literature leads the writer to believe that very low and very high humidity are both injurious to health, and that optimum humidity is dependent upon temperature. There is probably an optimum humidity for the best physical condition and for effective mental work, although it is likely that the range is wide. There is no consensus of conclusions. For a temperature of 20°C. Rubner advises a humidity of 30 to 60 per cent.; Uffelman, a humidity of 40 to 75 per cent. In this country we may well adopt a relative humidity of 45 to 65 per cent. as optimum. The range of comfort is wider — from perhaps 45 to 75 per cent. Although experimental evidence is slight, it seems clear that an optimum humidity is an important condition of efficient brain activity. — G. E. Partridge.

WOMEN AND CHILDREN IN INDUSTRY

The Case for Mothers' Pensions. *H. Scurfield.* The Child, Feb., 1920, 10, No. 5, 193–195. — "When a woman gives up the occupation for which she has been trained in order to get married, has a family and is then left a widow, the only thing which prevents her going back to her previous occupation, for which she was trained, is her children. It seems, therefore, equitable that the community should pay her for the work she does in bringing up

her children until they are fit to work for themselves, and that this payment should be free from any stigma of pauperism or charity."

The state should make an allowance for each child in every family, exceeding the number of four, under the school-leaving age. We need not concern ourselves much about the declining birth rate until we have made a proper effort to provide for the children that come into the world now, and have made provisions to abolish the widespread evil of child poverty. — G. E. Partridge.

Women in Transportation in New York City. U. S. Bur. Labor Statis., Month. Labor Rev., Dec., 1919, 9, No. 6, 290–292. — This article gives a summary of the findings of the New York State Industrial Commission which investigated the employment of women in the street, subway, and elevated lines of Greater New York in 1919. The investigation was carried on to anticipate, as far as possible, the probable effects of the enforcement of an act affording women the same protection as existing laws gave them in factories and department stores. The greatest opposition to the act came from the women themselves, who complained that through its enforcement their wages would be considerably reduced. The transportation companies in general had found the employment of women satisfactory, but it would be difficult for them to readjust themselves to meet the requirements of the proposed act. In spite of all opposition the act was enforced, with the result that most of the women were soon after discharged or sent to booths as ticket sellers at reduced wages. — R. B. Crain.

Women Workers in China. American Economist, Jan. 30, 1920, 65, No. 5, 76. — Great numbers of Chinese women are entering industrial life. In Shanghai about 70 per cent. of workers in the cotton mills are women and children. Working hours for spinners are from 6 in the morning until 6 at night, or from 6 at night to 6 in the morning. Weavers work from 5.30 in the morning until 7 at night and the wages are from 10 to 20 cents per day. In Canton there are 150,000 women in factories at a maximum wage of 40 cents per day. — G. E. Partridge.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Industrial Lighting Codes. *G. H. Stickney.* Electrical World, Feb. 14, 1920, 75, No. 7, 378–379. — Industrial lighting codes, fairly uniform in essential features, are now in force in six states, two having been added during 1919. The codes do not pretend to be in a final state. Probably the first need will be a more definite specification as to glare limits. This, however, must await the invention of a suitable instrument for the measurement of glare. — G. M. Fair.

The Fundamental Principles of Illuminating Design. Am. Arch., Feb. 25, 1920, 117, No. 2305, 261–263. — A discussion of the elements of light and light measurement. — G. M. Fair.

Maintenance of Interior Lighting Systems. *A. L. Powell.* Electrical Rev. (Chicago), Feb. 14, 1920, 76, No. 7, 263–266. — The proper maintenance of lighting equipment is a very important factor in illumination. Lamps should be discarded when the candle power has depreciated to 75 per cent. or 80 per cent. of the initial rating. The Mazda lamp is designed to maintain its candle power above these limits for an average burning period of 1000 hours. The accumulation of dust and dirt on the outside of the lamp and reflector is more serious than often realized. Proper voltages should be used to secure maximum efficiency of lamps, and all lamps and reflectors should be regularly washed. The question of color of walls and ceilings is very important. In general, paint is cheaper than electrical energy and in dirty plants painting or cleaning is especially recommended. Methods of systematic cleaning and studies of energy and cleaning costs are given. — G. M. Fair.

Air Conditioning in the Industries. *E. E. Leason.* Chem. and Metall. Engin., Feb. 11, 1920, 22, No. 6, 279–280. — A discussion of air conditioning in its relation to better health and improved manufacturing in the dye indus-

tries, candy factories, the baking industry, photography, lithography, and other lines of industry. — G. M. Fair.

Ozone as the Solution of the Fresh Air Problem. *E. S. Hallett.* Heat. and Vent. Mag., Feb., 1920, 17, No. 2, 25–26. — The writer sees in the use of ozone the solution of the fresh air problem. As a result of a year's test of ozone apparatus used in connection with the heating and ventilating of St. Louis schools, he comes to the conclusion that ozone destroys all odors resulting from human respiration and clothing; it produces mild exhilaration; removes toilet room odors and smells due to lodgment of dust in ducts; it has no odor itself when used in proper concentrations; it reduces weight in persons corpulent from inactivity, etc. — G. M. Fair.

Science and Art of Heating. *T. N. Thomson.* Plumbers' Trade Jour., March 1, 1920, 68, No. 5, 341–342. — This article, the first of a series on this subject, discusses the various types of heating systems in general, and explains the names and uses of the several parts of a heating system. — G. M. Fair.

The Prevention and Care of the Red Water Plague. *William H. Walker.* Plumbers' Trade Jour., Feb. 1, 1920, 68, No. 3, 178–180. — This paper read before the New England Water Works Association has already been reviewed in a previous issue of the Journal of Industrial Hygiene (1919–1920, Vol. 1, p. 178). — G. M. Fair.

Prevention of the Red Water Plague. Engin. N.-Rec., Feb. 19, 1920, 84, No. 8, 381. — Abstracts of a paper by *W. H. Walker* read before the New England Water Works Association and reported in a previous issue of the Journal of Industrial Hygiene (1919–1920, Vol. 1, p. 178). — G. M. Fair.

Studying Manufacturing Wastes in Connecticut. Pub. Works, March 13, 1920, 48, No. 9, 184–186. — A discussion of studies made in Connecticut on reducing pollution from plants engaged in manufacturing with metals, including recovery of metals from the waste and prevention of nuisance. The view of the Connecticut State Board of Health concerning disposal by dilution is given. — G. M. Fair.

Science and Art of Plumbing. *T. N. Thomson.* Plumbers' Trade Jour., March 1, 1920, 68, No. 5, 333–334. — As the first of a series of articles on the science and art of plumbing, this article gives a definition of common plumbing terms and an explanation of the different lines comprising a plumbing system. — G. M. Fair.

Design of Sewage-Purification Works. *A. C. Hewitt.* Abstracted from Commonwealth Engin., 1919, 6, 308–312 by H. C. Colson, Jr., in Chem. Abstr., Nov. 20, 1919, 13, No. 22, 2945. — "Difficulties encountered in designing purification works for small communities with especial reference to conditions in Australia are discussed. It is more difficult to secure a first-rate effluent at a reasonable cost in small community plants than in large ones. For primary treatment the septic tank, and for secondary treatment percolating filters with or without subsequent land treatment, is preferred. A suitable septic tank design for a small community (72 persons) is described in detail, accompanied by illustrations, together with percolating filter design and pump well." — W. O. Fenn.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

The Surgeon in Relation to Public Utilities. Part I. *Charles M. Harpster.* Mod. Med., Aug., 1919, 1, No. 4, 301–307. — An account of the organization of the medical department of the Toledo Railways and Light Company. A plan of the medical service department of this company is given, together with photographs of equipment. Examination forms of elaborate type are presented and their value commented upon. Actual data relative to the utility of the work accomplished appears in the continuation of this article in a subsequent number of the journal. — C. K. Drinker.

Employees' Hospital of Fairbanks, Morse & Company. *C. F. N. Schram.* Mod. Med., Aug., 1919, 1, No. 4, 322–324. — This brief article presents the distribution and char-

acter of surgical injuries occurring during the year 1918 among the employees of Fairbanks, Morse & Company, a summary of which follows: number of employees, 3500; number of injured employees, 9409; number of redressings, 37,742; number of cases of illness, 4084. A diagram is given showing the relative regional occurrence of these injuries to be: head, 280; eye, 2377; trunk, 120; arm, 274; wrist, 295; hand, 5512; lower extremity, 148; foot, 403. In another diagram it is shown that lacerations constituted 34 per cent. of the injuries; foreign bodies, 28 per cent.; abrasions 11 per cent.; contusions 10 per cent.; punctures 3 per cent.; burns 5 per cent.; miscellaneous, 9 per cent. Unfortunately similar data are not given for medical work. — C. K. Drinker.

Medical Service for Employees and Families at the Endicott Johnson Corporation. *L. D. Fosburg.* Mod. Med., Aug., 1919, 1, No. 4, 308–310. — A statement of the organization and the general manner of operation of the medical department in this corporation. — C. K. Drinker.

Seven Years of Industrial Medical Service for Montgomery Ward Employees. *Jeannette D. King.* Mod. Med., Aug., 1919, 1, No. 4, 316–321. — This article presents certain details of the operation of the medical service in this company, the most important of which are: Each department sends the names of absentees from illness to the medical department before 9 o'clock each day. If such employee wishes the doctor to call, a doctor is sent the same day; if he does not wish medical attention but fails to return to work on the second day, the visiting nurse makes the call. The visiting nurse also follows up all doctor's calls and gives bedside care when necessary. All hospital cases are sent to one institution since, in this way, they receive much better care than if sent to a number of different hospitals.

Physical examinations precede employment and permit utilization of cripples in certain jobs. Individuals found to be losing weight and reported to the medical department by members of the woman's club are looked over carefully and placed upon " the malted milk list," receiving thereafter an eight-ounce glass of malted milk between 9:30 and 10:30 o'clock in the morning, and between 2 and 3 o'clock in the afternoon. Such individuals are frequently weighed and are always under observation so that early tuberculosis is readily detected.

Six dentists are employed and serve the employees at cost. The statement is made that " 75 per cent. of our sicknesses are the result of infections in the teeth." This is such an extraordinarily high percentage as to cause some skepticism in regard to diagnoses. — C. K. Drinker.

Simple Health Literature for Employees. *Edwin A. Hunger.* Mod. Med., Aug., 1919, 1, No. 4, 321. — A statement of the health instruction pamphlets issued by the Eastman Kodak Company of Rochester, N. Y. — C. K. Drinker.

INDUSTRIAL NURSING

Industrial Nurse's Responsibilities and Opportunities. *Florence S. Wright.* Safety Engin., Oct., 1919, 38, No. 4, 221–222. — The responsibilities of an industrial nurse are summed up in the following:

1. To herself, that she develop her powers.

2. To her employers, that she perform faithfully what they have seen for her to do, while demonstrating the economic value of broader activity.

3. To the workers, that she serve them acceptably and with the authority that will win their heed to her teaching.

4. To the industrial physician, that she carry out his medical orders exactly and that she cooperate with him in all matters.

5. To the community, that she act in the best and broadest meaning of the term as a good and progressive civic as well as industrial servant.

The industrial nurse can best meet her responsibilities and seize her opportunities " by co-operation with her employer, who, if she gives evidence of ability and if she is careful to show by means of facts, through her records and reports, the wisdom and economy of each step she takes, will allow her reasonable initiative and freedom to co-operate with other department heads in the plant and who will aid all she does to become an efficient employee, a helpful friend to her fellow workers and a capable assistant to the industrial physician." — R. M. Thomson.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

The Model Town of Truxton. *W. H. Jennings.* The Southern Workman, Feb., 1920, 73–78. — Truxton is a town of 200 colored families in Virginia. It was constructed by the United States Housing Corporation. The houses are well built, of two stories, each house with five rooms and bathroom, and differing in exterior enough so that two houses alike are hard to find. Arrangements are being taken up for the purchase of the houses by the occupants on an easy-payment plan. The streets and sidewalks of the town are made of crushed and pulverized stone, and are arranged with reference to pleasing appearance. The absorbent sanitation system first tried failed, and now a sewage system with a connection for each house has been installed. The town has aroused interest and is being observed closely by large employers of negro labor throughout the United States. — G. E. Partridge.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

University Students' Intelligence Ratings According to the Army Alpha Test. *E. L. Noble* and *G. F. Arps.* School and Society, Feb. 21, 1920, 11, No. 269, 233–237. — Students of Ohio State University to the number of 5930 took the army tests. All the work was completed within three weeks of the date of examination. Tables show the distribution of cases according to college years; percentile ranks, sex differences and other data are given. The article is useful for purposes of comparison and contains suggestions in regard to group-testing. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

The Economic Value of Company Clubs. National Association of Corporation Schools Bulletin, Feb., 1920, 7, No. 3, 123–139. — A recent survey made by the Bureau of Labor shows that 127 firms, employing a total of 813,-904 workers, provide for their employees club rooms or club houses of some kind. These clubs range all the way from small single rooms in the plants to elaborate separate buildings. There are many types of clubs: Y. M. C. A., benefit associations, technical associations, and boys' and girls' clubs such as boy scouts. In some places there are provisions for racial associations. The equipments include libraries, gymnasia, musical instruments, recreational apparatus of various kinds. Some firms maintain country clubs and camps where workers can spend vacations, week-ends and holidays. — G. E. Partridge.

Community Service for the Negroes of the Lower Virginia Peninsula. The Southern Workman, Feb., 1920, 65–69. — This is a report of the development of community service from the war-camp community service in Newport News and Hampton. Communities are taking over the war-camp equipment at a small rental. The article contains a description of war-camp activities. — G. E. Partridge.

MALINGERING

Malingering. *Joseph Catton.* Mil. Surgeon, Dec., 1919, 45, No. 6, 706–717. — Catton asserts that out and out malingering is exceedingly rare but the minor forms, such as exaggeration and prolongation of illness, are quite common, especially in persons who are not normal mentally. Malingering should be looked for carefully in order that fraud may not be a drain on the efficiency of the military organization or upon the funds for hospitalization or compensation. The diagnosis of frank malingering should not be made until organic disease has been ruled out, hysteria eliminated, and proof of fraud demonstrated objectively or by the confession of the patient, nor until psychiatric examination has shown the absence of psychoneuroses, psychoses, inebriety, mental deficiency, and constitutional psychopathy. — H. A. Bulger.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

Workmen's Compensation. Eighth Annual Report of Industrial Commission of Wisconsin, July 1, 1918, to June 30, 1919, 80. — The eighth annual report of the Industrial Commission of Wisconsin states briefly the nature of the cases coming to the attention of the commission, the amendments to the compensation act, the contested cases, and the policy of the commission in regard to compensation insurance. Statistical tables are appended. Fifty pages are devoted to a discussion of the awards under the compensation act. — L. A. Shaw.

Occupational Diseases under Workmen's Compensation Laws. *Carl Hookstadt.* Mod. Med., Aug., 1919, 1, No. 4, 311–315. — Physical impairment produced by slow development of a disease that has its origin in the processes of an industrial occupation is no less an injury than the disability caused by accident. This broad interpretation of the term injury is recognized in Great Britain, Argentina, Brazil, New South Wales, Switzerland, the Union of South Africa, and Canada, with the exception of Quebec and Saskatchewan. In the United States, however, only six workmen's compensation jurisdictions (California, Connecticut, Hawaii, Massachusetts, Wisconsin, and the federal government) provide compensation for occupational diseases. State compensation laws which do not accord full recognition to this principle need enlargement to include occupational diseases. — C. K. Drinker.

Insurance Facts for Employment Men. *Harry W. Kimball.* Ind. Management, Jan., 1920, 59, No. 1, 73–75. — Mr. Kimball calls attention to the " five major hazards to which almost all workers are liable " — death, sickness, accident, old age, and non-employment. In the case of accidents it is suggested that compensation granted by the state is usually inadequate. In some instances this inadequacy is overcome by employers supplementing the compensation. Mutual benefit societies are playing an even more important part in adding to the worker's income during incapacity.

Much constructive work has been done to reduce illness; however, in spite of health campaigns, workers are still subject to loss of time from this cause. Here again the mutual benefit association plays an important part. In some cases employers share in the expense of health insurance for their workers. In the case of the hazard of death, industrial concerns can do much by encouraging and advising with employees in taking out insurance with reliable companies. In many instances concerns are supplementing this form of protection by a group-insurance plan.

In connection with unemployment, the writer suggests that it is just as proper for a company to lay by funds to protect its workers against unemployment as it is to establish a fund to provide dividends during slack times. — C. H. Paull.

Compulsory Sickness Insurance a Menace. Am. Industries, Feb., 1920, 20, No. 7, 37–38. — This is a résumé of the recommendations of a special committee of the Medical Society of the State of New York. The report of this committee calls attention to:

1. Most illness leading to poverty is of long duration and usually extends beyond the period of twenty-six weeks for which benefits are provided.

2. The medical service provided under the insurance scheme is already being rendered more satisfactorily by physicians under the system of private practice.

3. Under a system of sickness insurance the morale of the medical profession tends to deteriorate.

4. The new scheme of public health administration would tend to destroy the existing machinery of health administration which has been found to be effective.

In view of these and other considerations the committee recommended that a sufficient appropriation be given the state health departments to permit them to establish the exact relation between character of illness and economic condition. — C. H. Paull.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II | JULY, 1920 | NUMBER 3

CONTENTS

GENERAL

CLINICAL TYPES OF OCCUPATIONAL DISEASES: STUDY OF METHODS FOR THEIR PREVENTION. *Louis I. Harris.* Jour. Am. Med. Assn., Sept. 20, 1919, 73, No. 12, 880–886. — Industrial hygiene, industrial surgery, and industrial medicine have begun to emerge clearly into view as most important special branches of modern medicine. The sources of danger to the lives and health of workers are adequately illustrated in this article by examples of carbon monoxide poisoning, carbon dioxide poisoning, anthrax, and various other forms of chemical poisoning.

Practically all the medical schools have thus far failed to include in their curriculum the study of industrial hygiene and of occupational diseases. The medical clinics which are connected with universities for teaching purposes should utilize to better advantage than they now do the wealth of clinical material available for the study of occupational diseases. A great opportunity for the study of occupational diseases likewise presents itself to physicians who are employed by various industrial corporations and in connection with whose work a variety of health hazards exist. It is a deplorable fact, however, that the great majority who accept employment as factory physicians are content to conduct what are essentially merely dispensaries for the purpose of rendering emergency service in cases of accidents. In only a few instances have state or municipal health officers included the subject of industrial hygiene and the prevention of occupational diseases in their programs.

Taking the country by and large, there is little evidence that labor organizations have even begun to appreciate that the campaign for the protection of the health of those in industry is quite as vital to their interests as

better wages and shorter hours, to the procurement of which they have thus far limited practically all their efforts.

The future development of industrial hygiene and medicine hinges on a reform of the curriculum of the respective medical schools and on the sympathy and willingness of private physicians and hospitals to aid in protecting the public welfare. It is essential, too, that there should be co-operation between the different state and federal health organizations and, what is even more important, there must be authoritative leadership. — L. A. Shaw.

Industrial Hygiene. Med. Times (London), 48, No. 2113. — This editorial comments upon the fact that although industrial medicine and surgery constitute an integral part of industry, the health of industrial workers has not received in the past the attention that it should have. During the war much good research work was done and some attempt is being made to continue it. The efforts of the Factory Branch of the Home Office have resulted in many important advances in industrial hygiene. America is ahead of us in this field, but there is no reason why Britain should lag behind. The article advocates the establishment of a health committee in every factory. Co-operation between employer and employee is essential. — A. F. Kent.

The Johns Hopkins University School of Hygiene and Public Health. Quart. Bull. Louisiana State Board of Health, Dec., 1919, 10, No. 4, 220. — The Johns Hopkins University School of Hygiene and Public Health announces its first intensive course of instruction to meet the needs of public health officers and of physicians proposing to enter upon public health work. — L. A. Shaw.

The Owen-McDuffie Bill for the Creation of a Department of Public Health. Educational Record, Jan., 1920, 1, No. 1, 15–16. — An outline of the proposed bill (S. 814 and H. R. 5724) to create a Department of Public Health, with a secretary in the Cabinet and an assistant secretary. The department will have a Bureau of Sanitary Research, Bureau of Child Hygiene, Bureau of Vital Statistics, Bureau of Food and Drugs, Bureau of Quarantine, Bureau of Sanitary Engineering, Bureau of Government Hospitals, Bureau of Personnel and Accounts. Ten million dollars are to be appropriated for co-operation with the states in promotion of public health on condition that the states match the appropriation. — G. E. Partridge.

War-Time Revelations in Physical Education. *T. A. Storey.* Am. Physical Education Rev., Feb., 1920, 25, No. 2, 47–52. — The state of peace-time physical education has been deplorable, as was shown by the generally poor habits of constructive hygiene found in our soldiers. Less than 5 per cent. of our young men and women have received physical education in school. At least 50 per cent. of the population need some reparative or corrective hygiene. At the present time only twelve states require any form of physical education in the school. To meet some of these conditions the U. S. Interdepartmental Social Hygiene Board has laid out a program for assisting in the establishment of departments of hygiene in normal schools and other educational institutions. — G. E. Partridge.

The Training of Physical Educators. *C. W. Hetherington.* Am. Physical Education Rev., Feb., 1920, 25, No. 2, 61–62. — "We must conceive a physical education as the constructive educational source of organic development and therefore health; the source of the fundamental phases of character, discipline and moral training; and the source of skill at the foundation of all efficiency. It is the foundation of all education; the rest is the superstructure and must be built on a solid foundation of physical education." — G. E. Partridge.

Survey of Guelph Public Schools. *C. K. Clarke* and *C. M. Hincks.* Canad. Jour. Ment. Hyg., Jan., 1920, 1, No. 4, 342–346. — Out of a school population of 2245, it was found that 3.34 per cent. had an intelligence quotient of 75 per cent. or less. For these seventy-eight patients special industrial classes were recommended, in which the curriculum should comprise academic work, handiwork, games, gymnastics, etc. This was done in an endeavor to develop each child to the limit of his capacity and to train him in healthy physical, mental and moral habits. — S. Cobb.

Vocational Psychology. *E. Stern.* Zeitschrift für die gesamte Neurologie und Psychiatrie, Feb., 1920, 20, No. 2, 87–115. — The

writer undertakes to present a brief summary of the development of vocational psychology, giving the credit for its beginning to Münsterberg, followed in Germany by Stern and Lipmann. A section is given to the Moede-Piorkowski-Wolff tests used in the Berlin schools in distributing children from the lower to the higher schools, and to similar applications of psychology. The psychological characteristics of occupations, attention-types, etc., are mentioned. The author divides the problems of vocational psychology into two groups: the problem of testing an individual with reference to placing him in the most suitable occupation, and, secondly, the problem of deciding whether an individual is suited for a certain occupation. In one case the man is given, in the other the occupation, as the starting point. Stern reports in summary his own tests for aviators.

The article is a useful guide to recent German literature in the field and may well be read in connection with the earlier and more elaborate analysis of the field of occupational psychology by C. Piorkowski, *Beihefte zur Zeitschrift für angewandte Psychologie und psychologische Sammelforschung*, ii, 1915. — G. E. Partridge.

An Experiment to Determine the Relation of Interests to Abilities. *R. Hartman* and *J. F. Dashiell*. Psychological Bulletin, Aug., 1919, 16, No. 8, 259–262. — There still exists, in regard to the problem of vocational guidance, much doubt about the relation between interests and abilities in the activities in which the interests lie. Upon this subject we need exhaustive studies from several points of view. In the writers' experiments tests were made, such as the word-completion test, code writing, tests for retention, arithmetical problems, pitching pennies, letter cancellation, and the subject was asked to record the degree of his interest in the tests. A positive correlation of .243 was found between ability and interest. The highest correlation for the total work of an individual was .915. — G. E. Partridge.

The Social Unit Plan as a Means of Democratizing Social Work. *E. T. Devine*. The Journal of Delinquency, Jan., 1920, 5, No. 1, 9–14. — For two years and a half the National Social Unit Organization has experimented in community organization in the Mohawk-Brighton District in Cincinnati, Ohio. The district has a population of 15,000. Here all residents take part or may take part in the block-councils, elect block-workers, etc. Prospective beneficiaries are consulted in advance about their needs. In the block-councils projects are decided upon, and then experts are called in to determine ways and means. All the agencies engaged in field work in the district regard the intensive block-organization as successful. The result of the system is especially that all cases become thoroughly discussed in the Social Workers' Council, and in this way the social agencies of the city have been brought closer and made more accessible. — G. E. Partridge.

The Social Service Problems of the Jewish Immigrant. *David H. Fauman*. Canad. Jour. Ment. Hyg., Jan., 1920, 1, No. 4, 323–328. — Racial peculiarities and their results are discussed in the light of the history of the European Jew, as are also the effects of sudden emancipation in a new country both on the adults who have immigrated and on the children born in the new environment. — S. Cobb.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Malignant Tumors of the Bladder in Workers in the Organic Chemical Industry. *Max Nassauer*. Abstracted as follows from Z. angew. Chem., 1919, 32, 333–335, by J. S. Hepburn in Chem. Abstr., March 20, 1920, 14, No. 6, 777–778. — "Malignant tumor (cancer) of the bladder occurs as an occupational disease among workers who come in contact with aniline vapors. The occurrence of this disease among workers engaged in the manuf. of benzidine is probably due to the aniline, 4 to 5 % of which is formed as a by-product. The disease is produced only if the aniline be inhaled as a highly dild. gas; solid benzidine did not produce disease of the bladder when introduced in the dry powdered state into the digestive canal and the respiratory tract. The workmen attacked by the cancer

have not been engaged in evapn. or distn. of pure benzidine, but have been employed in adjoining buildings of the factory or in the open air, and have inhaled the aniline vapors highly dild. with air. The poison, inhaled in very small amts., is dissolved in the moisture of the alveoli, and enters the cells and the lymph or blood streams without producing direct symptoms of intoxication. Since aniline is comparatively easily sol. in water to a 3% soln., while benzidine is scarcely sol. in water and quite insol. in the salt-containing fluids of the cells, aniline, and not benzidine, must be the poison. Moreover, tumor of the bladder has not been noted among workmen who have been exposed for 20 and more years to extremely fine dust of aniline-free benzidine. The poison is oxidized or otherwise altered in the animal body, and the products are excreted, in part, by the feces, urine and perspiration; however, a portion of these products remains in some, as yet undetd., part of the body, and, after the lapse of time, attains a certain threshold, and stimulates the epithelium of the bladder to the formation of new cells and malignant growth. A workman may be employed on the av. for 16 years before the first symptoms of the disease appear. Of the operations for tumors of the bladder made at the surgical clinic of the Univ. of Frankfurt during a period of 23 years, from 25 to 30% were for tumors produced by aniline." . . . Methods for the proper ventilation are described. "As to personal hygiene, workmen with either constitutional or cutaneous diseases must not be employed. Employes suffering from even the slightest attacks of diseases and injuries of the skin and air passages should cease work until completely recovered. The urine of each workman should be examd. at intervals of 8 days. . . . Employes, in whom, in the absence of other diseases of the urinary system, even the slightest leucocyte content appears in the urine, must be removed from the plant permanently, and must work in the country air, and be continually under the observation of a specialist in urology. Workmen may not labor for longer than 3 months in plants in which they are exposed to the poisoning." — W. O. Fenn.

MENTAL

The Recognition and Better Treatment for Mental Nervous Injuries. *Francis D. Donoghue.* Mod. Med., Dec., 1919, 1, No. 8, 671–674. — "The volitional index of a patient determines the degree of co-operation that may be counted upon in bringing him back to efficiency. Psychic fear, with or without physical injury, may induce a set of inhibitions most baffling to control. With the possibility of compensation, there is added the question of motives which further confuses the issues. The care of such cases constitutes one of the most difficult problems of accident boards, and their classification demands the most impartial consideration of the scientific mind." — A. B. Emmons.

The Smith College Experiment in Training for Psychiatric Social Work. *W. A. Neilson.* Reprinted from Ment. Hyg., Jan., 1919, 3, No. 1, 59–64. — This paper describes the experiment undertaken at Smith College in the summer of 1918 in establishing a method for training psychiatric social workers for war-time needs, and outlines the scheme in preparation for continuing this training to meet the requirements of peace times. "How long the work will be continued, how far it will be developed, depends entirely upon the reception given to the products of the school by the profession, and the supply of material." It is anticipated that before long the value of the profession will appear so obvious to the community at large that the demand will greatly exceed the supply. — M. C. Shorley.

The Mentality of Convalescence. *E. A. Bott.* Canad. Jour. Ment. Hyg., Jan., 1920, 1, No. 4, 302–312. — Much can be done by directly interviewing patients during convalescence in order to get into personal touch with them and understand their personal problems, as well as to impress and stimulate them. For each negative element of the mentality of convalescence "is substituted a positive one based on powerful emotions which the veteran knows. Instead of allowing the patient to relinquish responsibility he is forced to assume it by having him measure up to expectation in working out his own salvation day by day. His extreme suggestibility is taken advantage of to impress a constructive programme stimulated by the instincts of sport and competition. His false idealism which would forget the facts and look for relief to something outside or beyond reach is banished by converting him to an enthusiastic use of practical means at hand. Lastly, his strong gregarious habits are utilized to cultivate an atmosphere of cure

rather than of convalescence. Establish the conviction of improvement in individuals and it will spread through a whole patient population, then collective treatment may complete the process."

"Among the problems of the future therefore will be the proper balancing and interrelating of technics that will be most appropriate to convalescence in the widest sense. The mental attitude of patients in war service is complex, but is immeasurably simpler than the points of view met outside the service where patients of both sexes and all ages await similar assistance. To find the facts about the attitude of workers in industry, for instance, is a vital task to-day that is little more than commenced. If medicine, therefore, sees new service in the field of industry ought not the psychological factor to have a place in its programme and an influence on its therapeutic procedures ? " — S. Cobb.

Facial Expression as an Index of Mentality. *C. Burt.* Child-Study, June, 1919, 12, No. 11, 3. — Notwithstanding the practical importance of facial expression as a general indication of mental characteristics, there has been very little study of its validity or trustworthiness by the methods now in vogue for testing the diagnostic value of mental symptoms and reactions. Some preliminary experiments on the problem are reported in the above paper. In these tests estimates were made from the study of facial expression and general impression of the subjects in regard to twenty-nine qualities of character and intelligence, and these estimates were compared with judgments made by other observers on the basis of acquaintance with the subjects. Other calculations were made from the study of photographs. It was found that judgments based upon photographs are of little value as compared with those based upon direct observation of the face in movement, although some characteristics are reliably shown by the photographs. In direct observation judgments about general qualities (general physical vitality, general emotionality, general intelligence, and general moral character) are far more accurate than judgments about specific qualities. Physical and emotional qualities betray themselves in the face far more readily than qualities of intelligence or of moral character. Specific emotional qualities are much more easily diagnosed than specific intellectual qualities. "The power to read the face seems then, in part, at least, to involve a teachable technique." — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Industrial Poisoning in Chemical Manufacture. Review of War Years. *T. M. Legge.* Abstracted as follows from Chem. Trade Jour., 1919, 65, 385–388, 411–413; Chem. Age, 1919, 1, 465–467, by J. S. Hepburn in Chem. Abstr., March 20, 1920, 14, No. 6, 775–776. — "L., who is British medical inspector of factories, reviews poisoning and disease of an industrial origin occurring during 1915–1918, both inclusive. All risk of Pb poisoning lies in the inhalation of the dust or fume, and may be avoided if these be removed or prevented. Poisoning in the manuf. of P occurs chiefly in the condenser plant; improvements in handling the crude P and the P-mud reduce their exposure to the air, and the amt. of fume, and thereby decrease the liability to poisoning. Arsenic poisoning was produced by fumes of $AsCl_3$ which was made by distn. of a mixt. of As_2O_3, NaCl and H_2SO_4. Examn. of the hair and urine of workmen in this plant showed the presence of material amts. of As and indicated degenerative changes in the kidneys. The symptoms (ulceration of the skin) were those produced by dusts and salts of As. Poisoning by AsH_3 may occur in the chem. and dye industries from the action of Zn dust on HCl. Use of HCl free from As will decrease the danger, but the Zn may also carry As. The reaction should be carried out in an enclosed vessel in which a slight negative pressure is maintained, or an ample exhaust draught must be maintained at the vessel. Mercurial poisoning increased during the war as a result of the increased use of Hg fulminate in detonators. The symptoms produced were dermatitis, conjunctivitis, and inflammation of the nasal and laryngeal mucosa. Washing with a 10 % soln. of $Na_2S_2O_3$ aided in the prevention of the rash and ulcers; use of a 2 % soln. of this salt as an eye-wash proved beneficial. Toxic jaundice was produced by tetrachlorethane

(used as an airplane dope), trinitrotoluene, and dinitrotoluene. To prevent the poisonous action of dinitrotoluene, recourse was had to exhaust ventilation, personal cleanliness of the workmen, and daily examn. of their urine for the compd. Exposure to enveloping nitrous fumes for more than 2 min. produces asphyxiation and death. Exposure for 0.5 to 2 min., followed by apparent recovery on return to the open air, may cause pulmonary edema a few hours later with fatal termination. Daily exposure to small amts. frequently causes chronic bronchitis. Benzene vapors may give rise to acute poisoning with fatal results. Before a tank or other vessel which has contained benzene is entered, it should be thoroughly boiled with water while raking any sediment in it, then should be filled with water and emptied immediately before entry; a respiratory app. drawing its air supply from without the tank should be worn. In the manuf. of briquets with pitch, ulceration of the skin and of the cornea, and epithelioma may attack the workmen. Industrial dermatitis may occur in machine shops where cutting oils, sol. oils, and cutting compds. are used on lathes and similar machines. Inflammation of the hair follicles, septic infection, and eczema occur. The best preventative is cleanliness; for both prevention and cure, the hands and arms should be washed before and after work, then powdered with a mixt. of equal parts ZnO and starch. Various other irritants produce dermatitis." — W. O. Fenn.

Carbon-Monoxide Poisoning in Warfare. *W. J. Rutherfurd.* Lancet, Jan. 24, 1920, 198, No. 5030, 184–188. — A brief discussion of symptoms resulting among sappers from single exposure to gases following mine explosions, illustrative cases of which are cited. The CO content of various gas mixtures is given. No mention is made of chronic symptoms due to frequent exposure to small amounts of gas. — H. S. Forbes.

A Report of Five Cases of Poisoning by Nicotine. *William D. McNally.* Abstracted as follows from Jour. Lab. and Clin. Med., 1920, 5, 213–217, by E. R. Long in Chem. Abstr., April 10, 1920, 14, No. 7, 980–981. — "Three cases of nicotine poisoning following drinking of insecticide containing approx. 40% nicotine are recorded, in which no autopsy was made. In two other cases about 30 cc. of 40% nicotine soln., mistaken for whiskey, was imbibed, death following within 5 min. Intense hyperemia of the gastro-intestinal tract was noted at autopsy. The stomach of one contained 0.7702 g. nicotine, the other, 4.9609 g. The literature is reviewed and the methods of detn. are considered. . . ." — W. O. Fenn.

Poisoning by Gases from an Ammonia Factory. *Leybold.* Abstracted as follows from Jour. Gasbel, 1916, p. 256, and Zentr. Biochem. Biophys., 19, p. 285, by H. S. Paine in Chem. Abstr., March 10, 1920, 14, No. 5, 576. — "L. describes a case of fatal poisoning by gases (H_2S and HCN) evolved in the prepn. of $(NH_4)_2SO_4$." — W. O. Fenn.

Chronic Arsenic Poisoning from Drinking Water. *C. Alvarez.* Revista Médica del Rosario, Dec., 1919, 9, No. 5, 311. Abstracted as follows in Jour. Am. Med. Assn., Feb. 28, 1920, 74, No. 9, 636. — "Alvarez publishes two further cases of what he calls Bell-Ville disease, as the first cases of this chronic intoxication from arsenic-containing water were observed at Bell-Ville in northern Argentina. The new cases were in men of 25 and 62 and after abandoning the use of water from a certain well, both recovered completely from the severe clinical picture they presented at first. In the young man the liver was predominantly affected, and ascites required tapping twenty-one times. In both the skin showed dark pigmentation, with scattered white and black dots."

Mercurial Poisoning. *R. P. Albaugh.* Mod. Med., Nov., 1919, 1, No. 7, 562. — This article takes up very briefly the occurrence, symptoms, prevention, and treatment of mercurial poisoning. — L. A. Shaw.

Benzol Poisoning. *R. P. Albaugh.* Mod. Med., Dec., 1919, 1, No. 8, 670. — A brief statement of the symptoms, prevention, and treatment of benzol poisoning. — A. B. Emmons.

Non-Fatal Poisoning by Sodium Fluoride. *C. Vallée.* Abstracted as follows from Jour. pharm. chim., 1920, 21, 5–8, by S. Waldbott in Chem. Abstr., March 10, 1920, 14, No. 5, 577. — "Seven persons were poisoned partaking of some pastry, in the prepn. of which NaF was used by mistake in place of $NaHCO_3$. The amt. absorbed by each was about 0.228 g. NaF, except 0.456 g. in 1 case. Gastralgia, nausea and vomiting followed, the attack lasting 3 to 6 hrs., in the 1 case 12 hrs., followed by 36 hrs. of general weakness. Milk aided in the recovery." — W. O. Fenn.

DUST HAZARDS AND THEIR EFFECTS

Dust Inhalation and Miner's Phthisis. *H. W. Davies.* Abstracted as follows from Science Progress, 1919, 14, 329–330, by J. S. Hepburn in Chem. Abstr., March 20, 1920, 14, No. 6, 777. — "Miners who inhale silica dust are especially susceptible to tuberculosis, while miners who inhale coal dust are not especially susceptible to that disease. Inhalation of silica dust mixed with dust composed of coal or clay is relatively harmless. Expts. on guinea pigs showed that the dust was taken up by the epithelial cells in the alveoli of the lungs. With silica dust, these cells then remained in place, and gave rise to fibrosis and increased susceptibility to tuberculosis. After taking up the coal dust, and its mixt. with silica, these epithelial cells became detached and wandered out. Since addition of coal dust rendered the SiO_2 harmless, it is suggested that coal dusting be used in quartz mines to prevent miner's phthisis." — W. O. Fenn.

The Efficiency of Certain Devices Used for the Protection of Sand Blasters against the Dust Hazard. *C.-E. A. Winslow, L. Greenburg,* and *E. H. Reeves.* U. S. Pub. Health Ser., Pub. Health Rep., March 5, 1920, 35, No. 10, 518–534. — In most industrial plants the protection of the worker against the hazard of industrial dusts is effected by reducing the dust content of the air to a reasonable level, by the use of exhaust hoods and suctiou fans, by carrying on dust-producing operations in enclosed spaces, or by substituting wet processes for dry grinding. In other industrial processes it is impossible to render the air sufficiently free from dust to avoid danger. In such cases, protection can be attained only by the use of helmets, masks, or respirators; but the discomfort to the person wearing them renders them, for the most part, impractical.

Studies made upon different forms of respirators by Kobrak and Schablowski are recorded in Volume 68 of the Zeitschrift für Hygiene for 1911. The same subject is also dealt with in the General Report of the Miners' Phthisis Prevention Committee of South Africa, issued in 1916 (pp. 28–30).

The authors herewith present the results of their investigation of the problems that arose in the sand-blasting department of a large automobile factory in Connecticut. Tables, diagrams and conclusions are included. — L. A. Shaw.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Occupation in Relation to Tuberculosis. *George M. Kober.* U. S. Pub. Health Ser., Pub. Health Rep., March 26, 1920, 35, No. 13, 751–759. — As a result of numerous independent investigations it is known today that persons habitually engaged in hard work, especially in factories and indoors, present a greater amount of sickness and a higher mortality than persons more favorably situated, and that the character of the occupation influences to a great extent not only the average expectation of life but also the prevalence of certain diseases.

In addition to the germ which is the approximate cause of infection, in the case of tuberculosis there must also be a suitable soil for the development of pathogenic effects. Such soil is usually found in persons of feeble physique. A vulnerability of the tissues may also be acquired by indoor life and dusty occupations, especially when the work involves exposure to dampness, extremes of heat and cold, sudden changes of temperature, and exposure to industrial poisons. The author is not disposed to overrate the dangers of indoor life and occupations, but he feels that if the necessary precautions are neglected there is every reason to assume that the habitual inhalation of vitiated air plays an important rôle in the causation of respiratory diseases. Inadequate floor space is found to be the cause of very frequent contact infections, as a result of which there is noted an undue prevalence of consumption, pneumonia, and septic sore throat.

Other bad effects in many indoor occupations result because the work is often performed by the worker while in a stooped position. All thoracic postural deformities naturally interfere with free expansion of the lungs and hence with the respiratory functions.

Owing to the numerous safeguards which

nature has provided to prevent the lodgment of dust in the lungs and in the trachea, only a small amount of dust actually reaches the lungs; but when, as a result of long continued exposure, this protective influence is diminished or ceases, dust will reach the air vesicles and produce mischief.

The author discusses the pathological effect of the different kinds of dust: municipal dust, general organic dust, vegetable fiber dust, animal and mixed fiber dust, mineral dust, and metallic dust. He is convinced that exposure to dust alone does not account for the undue prevalence of tuberculosis in certain occupations, and that every factor which undermines the general health of the individual is at least of equal if not greater importance in determining the course of the disease. Tables are arranged in such a manner as to show the percentage distribution of pulmonary tuberculosis in certain occupations in an ascending scale and according to exposure to the different varieties of dust. Comments are offered as to possible influence of physique, standards of living, and the effects of alcohol, lead, mercury, and other industrial poisons. — L. A. Shaw.

Railroads to Fight Venereal Disease. Soc. Hyg. Bull., Feb., 1920, 7, No. 2, 6. — At a joint conference in Atlantic City, January 8, of the officials of the U. S. Public Health Service, United States Railroad Administration and the American Social Hygiene Association, plans were put under way for extending the nation-wide antivenereal disease campaign to the several million employees of the railroads throughout the country. It was demonstrated that there was a definite relationship between venereal diseases and impaired efficiency, accidents and casualty costs. Several of the surgeons cited examples to show that men in the early and advanced stages of paresis were frequently found to be in charge of trains or in other responsible positions endangering the lives of the public and the property of the companies. The close relationship of venereal diseases and "unsafe practices" as understood by the Safety Section officials was asserted. — L. A. Shaw.

Syphilis. Med. Times (London), March, 1920. — This issue devotes much space to the various aspects of venereal disease, which, according to an editorial note, is a problem that must be faced. It is undermining the nation's health and is responsible for many cases of insanity, nervous diseases, blindness, etc. Dr. Mary D. Scharlieb deals with its effects on infants and children. J. E. R. McDonagh, in *Some Reflections on the Treatment of Syphilis*, says there is no such thing as a standardized treatment, and points out that as each patient's resistance is largely influenced by his mental attitude, the occasion often arises when the doctor can do more by suggestion than by drugs. He gives the following suggestions to be kept foremost in the mind of everyone who has a case under treatment: (1) Study the psychology of the patient; (2) diagnose clinically the type of disease; (3) prescribe intramine and colloidal iodine in the maximum course of arseno-benzene and mercury to increase the action of the metals and to prevent metallic intoxication and nervous manifestations; (4) in early cases supplement the maximum course with mercury, intramine and colloidal iodine prescribed intermittently for one or two years; (5) treat late cases symptomatically; (6) place no reliance on the Wassermann reaction as a guide to treatment or as a test of cure.

Dr. Thomas Dutton, in *Syphilis: Its Eradication and Treatment*, says, "This disease ought to have been stamped out years ago. Any amount of money spent in ridding the nation of this 'white plague' would be money well-spent and returnable four-fold by the extra health and work of all classes. Had scientific men, instead of commercial magnates, been at the head of the Government, it would have been, and what is more important, it would have been made an international question so that all European States would devise laws to prevent a person in a contagious stage of syphilis from going from one country to another and so spreading the disease." The writer goes on to criticize the "feeble attempt to grapple with the complaint" made by the government and lays down certain laws which should govern the treatment of cases. "In brief," he says, "the eradication of syphilis can be accomplished by (a) an international agreement, (b) payment of fees by the State, (c) perfect secrecy, (d) free choice of a duly qualified surgeon where consultations are in private, and (e) entirely ignoring the moral phase of the disease." He is dubious about the value of too much publicity, but thinks that something may be done by guardians or teachers.

Another equally outspoken article is by H. Wansey Bayly, under the apt title of *The*

Pharisaical Ostrich. He points out that leprosy, smallpox, typhus, yellow fever and malaria have been practically wiped out, or at least greatly reduced, while venereal disease has increased to the extent of being a racial menace. "This curious exception in the downward curve of infectious diseases is due to the fact that these diseases are preserved and protected . . . by an impenetrable zone of inky blackness. This protective surrounding fog is composed of a combination of ignorance, cant and humbug." "If venereal disease was frankly treated," he goes on to say, "in the same way as other much less deadly diseases are treated, by disinfection after exposure to risk, notification, segregation and enforced treatment, and stripped of its mantle of mystery, syphilis could almost certainly be exterminated in a generation." He criticizes severely the attitude of the London County Council who turned down the suggestion of the National Society for Combating Venereal Disease for the provision of early treatment centers. He looks with hope to the fact that women now have a vote, and is strongly in favor of immediate self-disinfection, which is anathema to many people and to many public bodies who dread making vice safe and consider fear of infection a useful deterrent.

The issue also contains useful summaries of memoranda issued by the Ministry of Health, the Medical Women's Federation, etc., together with abstracts of articles appearing in other British and American journals, and reviews of books dealing with this subject. Though none of the writers in this number deals with syphilis strictly from an industrial point of view, no excuse should be necessary for drawing attention to it in these pages. — A. F. Kent.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

The Detection and Treatment of Some Trade Eruptions. *R. Prosser White.* Med. Times (London), 48, No. 2113.—The writer remarks that the subject of trade rashes is often regarded as a special branch of dermatology and is thus relegated to so late a stage in the student's curriculum that he rarely masters it. The young practitioner seldom starts with a clear idea of eczema, seborrhea or impetigo. These diseases are readily altered, almost out of recognition, by the growth of secondary infections, chiefly staphylococcus and streptococcus, and the usual non-committal diagnosis of eczema is risked. Owing to recent legislation, occupational diseases of the skin have come into greater importance. Some of them fall under the head of trade accidents for which the patient can claim compensation.

The first question to be asked in examining a skin complaint is, Is it due to a toxin or organism circulating in the blood stream or is it caused by external irritation? Often there is a combination of these agencies. A fundamental difference between a professional and an idiopathic skin disease is that in the former the irritant acts from outside, and in the latter it circulates in the capillaries or the lymphatics. The writer holds that in a trade dermatosis the primary lesions begin as a folliculitis and from these apertures the inflammation spreads to the contiguous parts. Petroleum oil, tar, pitch, and soot, being slow acting agents, retain this distribution a long time and resemble an acneform eruption. Other trade agents and chemicals, such as lime, chrome, arsenic, and disulphides of sodium, at their commencement favor the same situation. Compare also the numberless dermatites caused by T.N.T., tetryl, and other explosive powders. With many of these agents the inflammatory reaction speedily spreads between the follicles. Such cases develop sheets of erythema or fine papules or vesicles, and are confused with eczema. The deeper red puncta of the open or even pouting mouths of the open stomata may be missed. The action of other strong chemicals is so intense that they corrode or burn the tissues, producing sores and ulcers. Constant maceration in the mildest alkaline solutions dissolves the horny layer of the skin which is its chief protection. In order of frequency, trade rashes are caused by the alkalies, lime, chrome, the coal and petroleum products, sulphide of sodium and arsenic.

A few chemicals irritate other parts of the cutaneous surface than those which are uncovered. Fine dusts are apt to fall inside the collar or under the cuffs. Certain drugs, such as phenylhydrazin, paraphenylendiamin and the toxins of certain plants, may precipitate rashes on the skin at a distance from the parts actually in contact. The writer gives some

valuable hints as to the diagnosis of trade eruptions and gives prescriptions for a paint, lotion and ointment, which he has successfully used. — A. F. Kent.

A Lecture on Miners' Nystagmus. *T. Lister Llewellyn.* Tr. Institution Mining Engineers, Feb., 1920, 58, Part 3, 167–182. — This article gives the history of miners' nystagmus, its symptoms, frequency, and cost. The liability to accident of men suffering from nystagmus, the factors determining the occurrence of the disease, such as age, occupation and method of work, the influence of seams, illumination, and the personal factors, and the prevention of nystagmus are discussed. — G. M. Fair.

Miners' Nystagmus. *J. Court.* Med. Times (London), 48, No. 2113. — A brief contribution to a subject which is attracting a great deal of attention in Great Britain at the moment. The opinion of experts is that the deficient light given by the safety lamp is the chief cause of miners' nystagmus. Miners suffering from myopia, hypermetropia, or astigmatism are more liable to contract the disease than are those with ordinary vision. A high percentage of cases have been found to show errors of refraction, in common with a large proportion of adult working men and schoolchildren, but these men seldom develop nystagmus when working in naked-light pits. The condition of lighting in all mines, says the writer, should be made equal to, or better than that where naked lights are used. There is also a personal factor and it is remarkable that so many young men have the complaint. Many bad cases suffer also from photophobia and night-blindness. Owing to the great improvement in lighting in all British collieries, however, bad cases are not nearly so common as formerly. Exhaustion and fatigue have a bad effect on some cases. When insanity is inherited, nystagmus may possibly be an exciting cause since many cases suffer from great depression of mind. Nystagmus should be looked on as a neurosis, and any means for the avoidance of eye-strain should be adopted. The writer discusses some improvements which might be made in the lamps, e. g., the use of amber-colored glass. — A. F. Kent.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Some Outstanding Facts in the Safety Movement. *C. W. Price.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 25–26. — "Accident prevention has offered the first legitimate common ground on which employer and employee can meet with mutual interest and understanding and with profit to both." The writer points out that the experience of thousands of industrial plants in which accidents have been reduced from 50 to 75 per cent. shows that not more than one-third of this accident prevention was possible by the development of mechanical guards or equipment. The rest was accomplished through effective organization and the development of safety education.

Among the important factors in arousing interest in safety have been state compensation laws. They have tended to define causes of accidents, and have placed the responsibility for accidents with employers. In spite of the rapid strides which have been made in accident prevention during the last ten years, it is pointed out that not more than 10 per cent. of the industrial plants at present have effectively developed educational work in safety. The ultimate success of the safety movement will not depend entirely upon the advances made in industry. It will be necessary for the safety idea to be carried into the community so that it becomes an integral part of the community life. Schools, public officials, clubs, churches, and civic organizations should all play their part in accident prevention. — C. H. Paull.

Prevention of Accidents by the Statistical Method. *Royal Meeker.* U. S. Bur. Labor Statis., Month. Labor Rev., March, 1920, 10, No. 3, 1–3. — Analysis of accident statistics is invaluable in detecting the cause of accidents, and especially in placing the responsibility for the more severe accidents, though in no case can responsibility be accurately placed. There must be the fullest co-operation between management and men if accidents are to be reduced to the irreducible minimum. Information regarding accident occurrence and results collected in a uniform manner from all industries and plants throughout the country and tabulated in a uniform

manner would enable the safety movement to be directed intelligently toward the reduction or elimination of the more severe accidents in the industries and occupations with the higher severity rates. — L. A. Shaw.

Non-English-Speaking Accident Frequency. *E. E. Bohner.* Safety Engin., March, 1920, 39, No. 3, 111. — A large part of the accidents in industry are traceable to a lack of knowledge of the English language. Not only is the accident rate higher among non-English-speaking employees, but there is not the same tendency to improve that is noted among English-speaking employees. The accident frequency rate among the non-English-speaking workers in a large steel concern, covering an eight-year period, was 2.3 times that among the American born. — R. Thomson.

Carelessness, Awkwardness, Ignorance, Stupidity Still a Menace. *George W. Bowie.* Safety Engin., Feb., 1920, 39, No. 2, 73–76. — Eternal diligence and vigilance are absolute necessities in our workaday lives. The evil of losing time through injury is becoming comparable with turnover and absenteeism, and can be reduced according to the extent and activity with which we combat the hazards of carelessness, awkwardness, ignorance, and possible stupidity of those who get injured, probably because the dangers and hazards which are incidental to their employment have not been fully explained to them. By proper instructions, the foreman can put the men he hires on their guard to protect themselves. — R. Thomson.

Protect Workmen by Inclosing Switches. *W. A. Waldschmidt.* Electrical World, March 27, 1920, 75, No. 13, 729–731. — Records show that exposed switches have been responsible for many accidents. The features of typical inclosed switches are discussed, together with the rules regulating the use of switches formulated by various private and governmental agencies. — G. M. Fair.

Grounding and Polarization as Protecting Measures. Part II. *W. J. Canada.* Electrical Rev. (Chicago), March 6, 1920, 76, No. 10, 391–394. — A discussion of how certain electrical circuits should be grounded to afford protection against fire and life hazard. — G. M. Fair.

Notes on an Explosion of Coal-Dust at Pennant Hill Colliery, near Dudley, Worcestershire. *J. R. Felton.* Tr. Institution Mining Engineers, Jan., 1920, 58, Part 2, 111–117. — A description of the circumstances attending the explosion at the above-mentioned colliery. — G. M. Fair.

The Safety Lamp and its Use in Chemical Industry. *W. Payman.* Jour. Soc. Chem. Indust., Feb. 28, 1920, 39, No. 4, 67–68R. — "The obvious precautions to be taken in order to prevent both explosions and fires wherever inflammable liquids are used are: (1) the use of some form of safety lamp where artificial illumination is required, and (2) the enforcing of rules similar to those usual in coal mines or explosives factories to prevent the introduction of any form of naked light." Such regulations should apply wherever a large surface of inflammable liquid may be exposed to the air, for example, in the preparation of dopes and varnishes, wherever inflammable products like rubber solutions are prepared or used in quantity, and wherever leakage may occur from plant or containers.

The author outlines the special claims made for the two kinds of safety lamps in use in the British Isles — flame lamps and electric lamps — and gives a general idea of the safety tests to which they must be subjected before they are approved by the Home Office. Although lamps are at present constructed to satisfy the special requirements of the coal miner, modifications will at once suggest themselves for lamps to be used in chemical works to increase their lighting efficiency without in any way interfering with their safety. — M. C. Shorley.

Accidents on Steam Railroads in the United States in 1918. U. S. Bur. Labor Statis., Month. Labor Rev., March, 1920, 10, No. 3, 159–160. — Statistics of accidents on steam railroads in the United States in 1918 are presented by the Interstate Commerce Commission in its Accident Bulletin No. 70, recently issued. Accidents are reported in three groups: train accidents, train-service accidents, and non-train accidents. A table furnishing casualty statistics is appended. — L. A. Shaw.

INDUSTRIAL SURGERY

Suture of War Wounds. *Drury Hinton.* Ann. Surg., Feb., 1920, 71, No. 2, 191–199. — An outline of the organization, types of cases, and technique used by the author in treating cases suitable for primary or delayed primary suture of war wounds. The results of this régime are given in the accompanying tables. — C. C. Lund.

On the Results of Bridging Gaps in Injured Nerve Trunks by Autogenous Fascial Tubulization and Autogenous Nerve Grafts. *Harry Platt.* Brit. Jour. Surg., Jan., 1920, 7, No. 27, 384–389. — The author concludes from the results of a series of eighteen operations, in which nerve grafts combined with fascial tubulization, and tubulization alone were used, that there was complete absence of any clinical sign of recovery. All of the cases had to have the bridged section excised later and the freshened ends directly sutured. — C. C. Lund.

Queen's Hospital for Facial and Jaw Injuries, Frognal, Sidcup, Kent, England. *L. W. Johnson.* U. S. Nav. Med. Bull., Jan., 1920, 14, No. 1, 17–65. — This article describes the hospital and some of the ingenious methods used by its surgeons in the treatment of very distressing deformities. The technique of the use of the tubed flap in plastic surgery, the repair of eyelids and eye-sockets, rhinoplasty, and the repair of bone injuries are among the other subjects included. — C. C. Lund.

WOMEN AND CHILDREN IN INDUSTRY

The Relation of Heavy Lifting to the Health and Output of Women. Bull. N. Y. State Ind. Com., Jan., 1920, 5, No. 4, 77. — No fair and satisfactory standards have been fixed either in this country or abroad on the question of lifting for women. In the report of the Health of Munition Workers Committee in England, it is shown that strain produces specific physical injuries and that output is decreased through the following causes: (a) irregular attendance at work; (b) dropping out of workers after they have been trained; and (c) fatigue great enough to limit output but not to force the worker from her machine. In this country New York State has taken the initiative to limit the weight to be lifted by women.

In the final analysis, however, it is concluded by employers both in this country and abroad that the matter of lifting heavy weights and of heavy work for women comes down to personal equation. Before a woman is permitted to do heavy work, she should be given a physical examination and her capacity determined by medical authority. — L. A. Shaw.

Protection of Maternity an Urgent Need. *Irene Osgood Andrews.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 47–50. — "Motherhood is now one of the most hazardous occupations open to women, according to the announcement of the federal Children's Bureau." In view of the foregoing statement the writer points out some of the important features of the maternity provisions in the Draft Convention of the First International Labor Conference. The conference recommended that a rest period of six weeks be provided after birth of children before women are allowed to return to work, and that they be given the right to leave work six weeks before childbirth. During absence from work the mother should be paid sufficient benefits to provide for the healthy maintenance of herself and child, and should be furnished free medical attendance. Special provisions are also made for the care of women who are forced to remain away for a longer time than that specified.

Provisions similar to those introduced into the Draft Convention have already become laws in many countries. Twenty-three countries at least and five states have provided rest periods both before and after childbirth. In thirteen countries maternity benefits are provided. New York, Massachusetts, Connecticut, Missouri, and Vermont forbid the employment of women for certain periods varying from two to four weeks before and after childbirth, but none of these states makes any provision for either cash benefits or medical service.

The importance of benefits and medical service is obvious not only in the case of the mother, but also in the case of the child. Since increase in the size of family brings with it no increase in income, additional expense for food and other service is apt to be impossible. — C. H. Paull.

International Congress of Working Women. Am. Child, Nov., 1919, 1, No. 3, 193–195. — At a meeting of the International Congress of Working Women held in Washington on October 28, 1919, it was resolved to register with the International Labor Conference of the League of Nations, in which women have no direct vote, demands on behalf of children gainfully employed. These demands are of interest in that they represent the views of the women of twelve nations. — L. A. Shaw.

New York State Conference on Child Welfare. Am. Child, Nov., 1919, 1, No. 3, 196–199. — At a conference on child welfare held in Albany, October 16, 1919, under the auspices of the state departments of labor, education and health, the following subjects were discussed: child labor laws and compulsory attendance laws; raising the minimum age at which children may leave school and enter industry; changes in the school system; and the establishment of continuation schools. — L. A. Shaw.

The Employment of School Children. *A. P. Gould.* The Child, March, 1920, 10, No. 6, 241–245. — Great hopes have been aroused by the new education bill, but the measure has been weakened by provision for local by-laws, especially governing the use of hours before school in the morning. It is highly important to eliminate such morning work. Too early rising has been declared by physicians to be detrimental to the health of many children who are employed in occupations demanding it. — G. E. Partridge.

The Provision for Occupation of Children out of School Hours. *H. R. Burpitt.* The Child, March, 1920, 10, No. 6, 246–249. — The hours that children work in the aggregate would be incredible to those who do not know the facts. One case is reported of a boy who worked eighty-three hours each week, including his school work. By-laws are coming in all over the country (England) limiting employment of children. The writer believes that the play centers are an important adjunct to laws in improving the condition of children, and he meets the objection that these public play centers take the child away from the home too much. — G. E. Partridge.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Code Governing Industrial Lighting in Places of Employment Including Factories, Mills, Offices and Other Work Places. Bureau of Labor, State of Oregon, 1919. — It has been shown by careful investigation in recent years that not less than 20 per cent. of preventable accidents are due either directly or indirectly to improper illumination. The 1919 legislature of the state of Oregon undertook, therefore, an important step towards the prevention of unnecessary accidents by providing for general and emergency lighting, both natural and artificial, in all places of employment. As a result, the Oregon Bureau of Labor has issued the above-mentioned pamphlet of seventy pages — a pamphlet containing the industrial lighting code adopted by Oregon together with explanations of the various provisions of the code, diagrams, photographs, and an industrial classification showing the minimum required values of lighting as directed in the code, with preferable values for a large class of work. — K. R. Drinker.

Inadequate Factory Lighting. *Thomas F. Chantler.* Safety Engin., Feb., 1920, 39, No. 2, 66–73. — The most complete table of lighting intensities yet published is that embodied in the tentative lighting code announced by the Industrial Commission of Ohio, a copy of which is included in this article. — R. Thomson.

On Ventilation. *J. J. R. MacLeod.* Pub. Health Jour., March, 1920, 11, No. 3, 101–118. — This article represents a scientific consideration of the principles of ventilation,

dealing with bodily comfort and its relation to the physical conditions of the environment; the causes of imperfect ventilation and its effect upon the physiological organism; the effects of temperature and the vitiation of the atmosphere; ventilation in its relation to infection; ideal systems of heating, ventilating, etc. — L. A. Shaw.

Science and Art of Heating — II. *T. N. Thomson.* Plumbers' Trade Jour., April 1, 1920, 68, No. 7, 494–499. — A discussion of the one-pipe steam heating system and the restrictions of its usefulness. — G. M. Fair.

Decay of Factory Roofs Checked by Proper Heating. Engin. N.-Rec., March 18, 1920, 83, No. 12, 578–579. — Artificial humidity and ineffective arrangement of heater pipes are conducive to rapid decay of wooden roofs. Methods of preventing the destruction of factory roofs are outlined. — G. M. Fair.

Drinking Water Facilities in Industrial Plants. *J. A. Watkins.* Safety Engin., Feb., 1920, 39, No. 2, 54–60. — The author discusses the general principles upon which the installation of drinking facilities for industrial plants should be based, and gives the following as the basic requirements of all drinking water systems:

1. The purity of the supply should be unquestionable.
2. The quantity supplied should amply meet the physiological needs of the workers.
3. The water should be palatable, i. e., free from disagreeable odor, color or taste.
4. The supply should be so distributed as to (a) insure proper temperature of the water at the time of consumption; (b) be conveniently accessible at all times to the personnel of the establishment; and (c) preclude the transmission of disease from one person to another. — R. Thomson.

Guiding Principles in Water Purification Plant Operation. *W. H. Dittoe.* Munic. Eng., March, 1920, 58, No. 3, 130. — A description of the care and supervision which water purification plants should receive. — G. M. Fair.

Water for Shipyard Drinking Fountains Treated by Violet Rays. *Walter L. Decker.* Engin. N.-Rec., March 18, 1920, 84, No. 12, 572–573. — A description of the purification by filtration and ultra-violet light disinfection of an industrial water supply, together with the results obtained as shown by bacterial analyses. A fuller discussion of the plant is found in Chemical and Metallurgical Engineering, Vol. 22, page 639. — G. M. Fair.

The Sterilization of Water by Means of Ultra-Violet Rays. *Walter L. Decker.* Chem. and Metall. Engin., April 7, 1920, 22, No. 14, 639–645. — A discussion of water disinfection by means of ultra-violet light with especial reference to its use in an industrial installation at Wyandotte, Michigan. — G. M. Fair.

Science and Art of Plumbing — II. *T. N. Thomson.* Plumbers' Trade Jour., April 1, 1920, 68, No. 7, 485–488. — This article deals with plumbing fixtures, old and new, and their kinds and classes. — G. M. Fair.

Rules for the Operation of Sewage Treatment Plants. *H. R. Abbott.* Munic. Eng., March, 1920, 58, No. 3, 134–135. — An outline of regulations governing the operation of all types of sewage disposal works.— G. M. Fair.

New Institutional Sewage Treatment Plant. *George L. Robinson.* Munic. Engin., April, 1920, 58, No. 4, 150. — A description of a small sewage treatment plant incorporating some novel ideas which may be of value to the designer of plants of limited capacity. — G. M. Fair.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Keeping Tab on Sickness in the Plant. *Dean K. Brundage* and *Bernard J. Newman.* U. S. Pub. Health Ser., Pub. Health Rep., April 9, 1920, 35, No. 15, 881–890. — General measures are less effective in accident prevention than are specific measures dealing with the conditions which are peculiar to each factory and to each particular occupation within the

factory. Notwithstanding the large sums of money which have been spent for sanitary improvements, the collection of information to ascertain the causes of and to locate the responsibility for the sickness occurring has been completely ignored.

The prevention of disease among industrial workers can be accomplished with scientific accuracy only by a properly administered system of morbidity statistics. The U. S. Public Health Service hopes to aid in the task of keeping tab on sickness in industrial establishments (a) by assisting plants in keeping and interpreting sickness records for their own use, and (b) in rendering the experience of these plants available for each other, as well as for any plant or individual interested in the prevention of sickness among wage-earners. — L. A. Shaw.

WHY A FACTORY DOCTOR'S SALARY COSTS LESS THAN NOTHING. *G. L. Howe.* Factory, March 1, 1920, 24, No. 4, 618–621. — The writer attempts to develop from data collected from different sources a tabulation of the major savings to an industry employing 1000 workers as a result of maintaining a medical department. Chief among the savings are:

1. Reduction of time lost through sickness with an estimated return to the company of $683.

2. Increase of output due to improved health of workers. The return to the company in this case would have to be worked out for each individual case.

3. Net saving to company by the elimination of infections — $2442.

4. Reduction of compensation payments — $1105.

The total of these major savings amounts to $4230. Besides these there are a great number of less tangible returns from medical service, so that the writer estimates that even if the medical department should cost from $5000 to $10,000 per year it would more than pay for itself. He calls attention to data, however, which tend to show that the average cost of medical service per 1000 employees is only $2210 per year or $2.21 per employee. — C. H. Paull.

HOSPITAL WORK IN A LARGE MACHINE-TOOL PLANT. *Sanford DeHart.* Am. Machinist, March 25, 1920, 52, 13, 658–660. — This article describes the means used to protect employees from sickness and accidents in the machine-tool plant of the R. K. LeBlond Co., Cincinnati, Ohio. The writer discusses cause of accidents, classification of injuries, and the scope of industrial hospitals. — G. M. Fair.

INDUSTRIAL NURSING

THE NURSE IN INDUSTRY. Nat. Organization for Pub. Health Nursing. — This folder is published by the National Organization for Public Health Nursing for the purpose of giving the public a clear and concise idea of just what the functions of an industrial nurse are, what her special qualifications should be, and how valuable her services are to industrial organizations. Particularly important are the paragraphs entitled, *Does It Pay to Employ an Industrial Nurse? How Do Insurance Companies Value a First Aid Room with an Industrial Nurse?* and *How May an Industrial Nurse Be Obtained?* All persons interested may obtain copies of this folder from the main office of the National Organization for Public Health Nursing, 156 Fifth Ave., New York City. — M. C. Shorley.

A COURSE IN NURSING SERVICE IN INDUSTRY. U. S. Pub. Health Ser., Pub. Health Rep., Feb. 6, 1920, 35, No. 6, 282. — Announcement is made that the New York University, School of Commerce, Accounts, and Finance, is offering a course especially arranged for industrial nurses, welfare workers, and those who contemplate entering the field of industrial welfare work. In the lectures and discussions special consideration will be given to such topics as the following: (1) duties and responsibilities of the nurse in small and large industries; (2) methods of teaching the worker and his family how to keep well; (3) most approved methods required for follow-up health service in the plant; (4) relation of the nurse to the industrial community; (5) home nursing and personal hygiene; (6) reducing labor turnover through health measures; and (7) amount of hospital care available for the worker. — L. A. Shaw.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Better Houses for Workers. *H. E. Miles.* Am. Industries, April, 1920, 20, No. 9, 26–31. — In reviewing a number of recent housing projects in this country, the writer calls attention to the importance of looking upon housing as a problem to be dealt with in a strictly scientific manner. "Every project must be laid out at the start as an entirety with every house designed for utility, for its own beauty and for its enhancement of the beauty of all others." Although the desirability of building houses for sale is uppermost in the minds of most people, it is highly important that some houses be provided upon a rental basis for the younger married workers who do not find themselves ready to begin the purchase of a house.

In summing up financial provisions and safeguards which should be included in a scheme for housing workers, attention is called to the following points:

1. "Build lasting structures with a view to loaning from twenty to sixty years on buildings and eighty on land.
2. "Keep the cost as low as consistent with quality. . . .
3. "Sell at approximately cost and on terms which wage earners of varying incomes can meet without anxiety or failure. . . .
4. "Form local housing corporations, with the aid of local chambers of commerce. Let manufacturers, merchants, and professional men buy the stock, and let this stock be limited to a dividend of six per cent.
5. "Ultimately — and why not now? — preserve the unearned increment in the housing corporation, as other nations do." — C. H. Paull.

Housing. Housing Betterment, Dec., 1919, 8, No. 4. — Contains many brief articles dealing with a variety of phases of the housing problem. There is a review of the Garden City experiment, "the only modern instance of the planning of a town as a whole," in which the essential features are the provision of an agricultural belt and the limiting of houses to twelve to an acre. The English after-the-war housing plans are described, particularly the provision for the erection of 29,000 new dwellings in London, and the project for the early clearance of the worst remaining insanitary areas of the city, now containing a population estimated at 40,000. The proposed model suburb in Quebec is described, and the housing situation in France, where building is practically at a standstill on account of high costs. The "hotel club" is proposed as the right way to house the single worker. A report of the results of a questionnaire addressed to workingmen and calling for data and expression of preferences in regard to housing contains some suggestions of value. The six-room house is in greatest demand, and the workingman is willing to pay for such conveniences as electric lighting, bath-tubs, and wash-tubs. Municipal housing as proposed in Pennsylvania, standardized fabricated houses, the housing of business women, the need of a million homes in the United States, the housing situation in several cities, general factors in house shortage are among the topics touched upon. — G. E. Partridge.

The Income Tax Versus the Housing Shortage. *Walter Stubler.* Nat. Munic. Rev., April, 1920, 9, No. 4, 204–206. — The writer, who has had broad experience in the handling of mortgage money in his connection with the Metropolitan Life Insurance Company, points out that one of the chief causes for lack of housing facilities at the present time is the difficulty which builders experience in obtaining mortgage money. Although there is plenty of money in the country, it is being invested in other ways. The reason for this is obviously that mortgages no longer pay as well as other investments. This is due in an important measure to the fact that the income tax reduces the income of large individual lenders of mortgage money so low that tax-free investments have become much more attractive.

In order again to induce money to flow into channels that will result in an increase in building activities, it is recommended that for a period of years returns from real estate loans up to a certain amount be exempt from income taxes. This would be a post-war emergency measure which would bring the relation between demand and supply in the housing field back to normal. — C. H. Paull.

Housing and Town Planning. *James White.* Canad. Engineer, April 1, 1920, 38, No. 14, 347. — A report on the activities of the Canadian Commission of Conservation. — G. M. Fair.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Planning a Personnel Department. *M. R. Lott.* Factory, March 1, 1920, 24, No. 4, 614–617. — The purpose of this article is to outline a possible organization for a personnel department in a plant employing 3000 workers and in one employing 1000 workers, and to indicate the duties falling to the different sub-departments and to the officers in charge of these departments. In a plant employing 3000 workers, the writer suggests grouping the activities of a personnel department under four heads: (1) employment; (2) factory conditions (safety and care of workers); (3) hospital; (4) mutual interest. In the smaller plant the work would be grouped under the direction of two officers, namely, the employment supervisor and the safety engineer. Organization charts are given for both of these plans.

The duties assigned to the hospital section in the personnel organization in the larger plant are:

1. Making physical examinations, including follow-up.
2. Providing first aid.
3. Rendering treatment in minor ailments.
4. Co-operating with the safety engineer in handling compensation cases.
5. Supervising factory hygiene.
6. Supervising educational work in hygiene for employees.
7. Maintaining records. — C. H. Paull.

Mental Tests in Practice. *A. G. Morphy.* Canad. Jour. Ment. Hyg., Jan., 1920, 1, No. 4, 336–341. — A critical discussion of the Binet-Simon intelligence tests and their practical applications. It is on the emotional and moral side that the tests are lacking. It must be borne in mind that any measuring scale is in fact merely a convention adopted for practical purposes and should only be used in connection with a complete study of each case, including all obtainable data — medical, educational, and social. — S. Cobb.

Measuring Intelligence. Journal of Heredity, Feb., 1920, 11, No. 2, 86–87. — The article contains a chart showing the measured intelligence of 36,500 men classified according to occupation. Engineer officers stand at the head of the list, followed by army chaplains, medical officers, Y. M. C. A. secretaries, and civil engineers. At the end come barbers, hostlers, concrete workers, farmers, mine drill runners, teamsters, general miners, tailors, and finally — lowest of all — laborers. The data have been reproduced from *Army Mental Tests.* — G. E. Partridge.

Tests of Discrimination and Multiple Choice for Vocational Diagnosis. *D. Sunne.* Psychological Bull., Aug., 1919, 16, No. 8, 262–267. — The Yerkes multiple choice apparatus and the McComas discrimination apparatus used in testing disabled soldiers for vocational diagnosis were used and the results show correlations between these tests and the Alpha tests of the army. The author believes these tests indicate some of the predominant characteristics of the subjects. Disabled men were also subjected to several tests of motor ability and the results of the experiments as a whole have proved to be of considerable assistance in selecting proper vocational courses for the men. — G. E. Partridge.

The Purposes and Methods of Psychological Tests in Schools and Colleges. *S. S. Colvin.* Education, March, 1920, 40, No. 7, 404–416. — In planning tests by which to measure general intelligence, we must be extremely careful to base the materials of the tests on the common experience of the group tested. For this reason there can be no general test for general intelligence. Psychological tests are valuable aids in forming estimates of ability, but they must not be followed blindly, and they should rarely be accepted as final without additional evidence of their validity obtained from all possible sources. — G. E. Partridge.

Condensed Guide to the Binet Tests. *S. D. Porteus* and *H. F. Hill.* Training School Bull., March and April, 1920, 17, Nos. 1 and 2, 1–39. — The Binet tests and the test procedure are here given in a concise and useful form, together with an historical summary and criticism of the methods. The proof of the validity of the Binet tests for diagnostic purposes has been mainly based on mass results,

and the agreement with experience in a very large number of cases has sometimes been taken as sufficient proof of universal validity. This is unjustified. Diagnosis is an individual matter and correct diagnosis is just as important in the case in which intellectual capacity is not the main factor in social fitness as it is in the case in which a Binet age test does give a fair indication of social efficiency. — G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

Pennsylvania Health Legislation of 1919. Pennsylvania Health Bulletin No. 103, Jan., 1920, pp. 39. — Such legislative acts of 1919 as directly affect the department of health are herein reproduced. — L. A. Shaw.

Employer's Responsibility for Occupational Diseases in France. Safety Engin., March, 1920, 39, No. 3, 142. — A schedule relating to lead and its compounds and to mercurial poisoning, included in the accident insurance law of France by the amendment of October 25, 1919. — R. Thomson.

American Experience with Workmen's Compensation. *Willard C. Fisher.* Am. Econ. Rev., March, 1920, 10, No. 1, 18–47. — It is less than nine years since the first of the really effective workmen's compensation laws was enacted in this country, and yet at the present time forty-two of the forty-eight states have compensation laws. In the ten years during which the compensation idea has had its rise, it has constantly gained friends. Although the provisions of early laws with regard to type of workers involved, waiting period, provision for medical care, etc., have been broadened from time to time, employers are hearty supporters of compensation. Insurance companies look upon it with favor. Labor, although apt to be hostile at first, is coming more and more to appreciate its desirable features.

To emphasize the social importance of compensation laws, attention is called to the amount paid in compensation in various states. In Wisconsin cash benefits between 1911 and 1918 amounted to \$5,144,000. California awards amounted to \$13,370,000 between January 1, 1914 and December 31, 1917. If the experience of Pennsylvania and New York were taken as a criterion for the entire country, an annual compensation payment of \$200,000,000 would be made. Although this amount seems large, it would not bring a very considerable sum to individual workers or to their families. In Pennsylvania the average award for fatal injury in the years 1916, 1917, and 1918 was \$2,383, \$2,272, and \$2,659 respectively. Small as these sums appear, they are much more satisfactory on the whole than the precarious damage payments obtained by the old method of litigation.

Undoubtedly, compensation laws with the resulting systems of compensation insurance have had something to do with the development of accident prevention work. The extent of this relationship cannot be definitely determined. Perhaps too much emphasis has been placed upon it at times. Accident prevention work was well under way in certain industries before the introduction of compensation laws. Undoubtedly, a variety of influences have been at work in bringing the safety movement to its present status.

Among the anticipated and the actual consequences of compensation laws are:

1. Promotion of safety by the establishment of rating systems.

2. Development of safety propaganda such as that used by the California Industrial Accident Commission.

3. There has been, contrary to expectation, no unsatisfactory reaction upon business as the result of compensation legislation.

4. Introduction of a humanizing factor into industry.

5. Protection of the worker in case of accident.

Among the defects of present compensation legislation are:

1. Where the rights of the injured worker are left to the decision of law courts, the results have been in some cases unsatisfactory.

2. Except in four or five states, there is a limit to the amount of medical attention granted to workers under compensation laws.

3. The customary waiting period of from ten days to two weeks cuts off compensation from a large number of deserving cases.

4. Several states do not as yet require insurance so that workers may be deprived of the benefits of the compensation law.

5. Awards are inadequate.

6. Present compensation laws do not protect a sufficient number of workers. They should be made more comprehensive.

In conclusion the writer says, "The sum of it all is that the American compensation laws have proved fairly their beneficence but cannot be supposed to have attained their final forms." — C. H. Paull.

Notices and Claims under Compensation Acts — I. *Chesla C. Sherlock.* Am. Machinist, March 4, 1920, 52, No. 10, 515–517. — This article deals with the technicalities incident to the reporting of accidents and the obtaining of compensation under the compensation acts. The necessity for prompt notification in case of accident is brought out in some detail. — G. M. Fair.

Notices and Claims under Compensation Acts — II. *Chesla C. Sherlock.* Am. Machinist, March 11, 1920, 52, No. 11, 560–562. — Some rules for the filing of a claim for compensation are given in this installment. The need for close observance of the prescribed rules is explained. — G. M. Fair.

Compulsory Health Insurance. *M. L. Harris.* Jour. Am. Med. Assn., March 27, 1920, 74, No. 13, 907–908. — Compulsory health insurance is an economic problem of first grade. There is scarcely a class of persons who would not be affected by it and the medical profession would be saddled with the obligation of carrying out the terms of the insurance. The arguments for compulsory health insurance are as follows:

"Compulsory health insurance is another step in the same direction as workmen's compensation acts, and if the latter are sound in principle and beneficial in their effects, the former, being but a step forward in the same direction, must likewise be sound in principle and beneficial in its effects. This conclusion is erroneous because of a lack of relation between the premises. The principle underlying workmen's compensation acts is definite and distinct, namely, injuries to workmen arising out of, and in the course of, their employment are a direct charge on the cost of production; but no such principle underlies compulsory health insurance. If accidental injuries to workmen were always preventable, it would be the duty of the state to enforce such rules and regulations as would effectually prevent their occurrence, instead of enacting laws to compensate the workmen in some manner for the damage done. It would not only be much cheaper to prevent the damage but infinitely more humane.

"Arguing along this line, the proponents of compulsory health insurance claim that as some diseases may be directly connected with the character of the work, all diseases in workmen should be compensated for the same as accidental injuries. There are many fallacies in this line of argument. In the first place, the diseases which are directly caused by the character of the work are very few indeed, and these can be readily prevented by proper working conditions. If a disease can be prevented by having proper working conditions, it is plainly the duty of the state to see that such conditions are provided, and not tax the people to cure a disease when it would be much easier and cheaper to prevent it. If there should be a disease which was caused directly by a particular line of work in an industry, and it were not preventable, then the care of a workman thus made ill should be a direct charge on the cost of production in the same manner as an accidental injury."

There are many economic conditions which have influence on the causation of disease, such as bad housing, overcrowding, inadequate diet, etc. Such conditions cannot be legislated against, and compulsory health insurance would be more likely to increase than to decrease the tendency to them by reason of the removal of restraint and responsibility for their betterment now resting upon the individuals in charge of industry.

"There are a few eminent members of our profession who believe compulsory health insurance to be desirable. These gentlemen have studied the subject from the point of view of the large city dispensary and clinic. They see a large number of poor people who visit these dispensaries daily and who, they believe, are not receiving adequate medical treatment. They argue that if all these patients were insured they would be able to pay the dispensaries for their treatments; the dispensaries would then be able to build up larger institutions, which could pay the attending physicians for their services, and thus provide the sick with better collective medical care. Any one who is

familiar with the dispensary evil and the suffering of the poor in the tenement districts of large cities will appreciate the point of view of the gentlemen who earnestly desire the betterment of the condition of these people; but isn't the dispensary question rather a local one? The same conditions certainly do not obtain throughout the country or even throughout a state. The commissions that have been appointed by several of the states to investigate the question of health insurance report that conditions vary greatly in different states and in different parts of the same state, and some of the commissions see no necessity for the adoption of compulsory health insurance. It will be admitted that the dispensary question and inadequate medical care of the poor in large cities are serious problems, and it is even possible that compulsory health insurance might bring temporary relief; but it would be at the expense of future harm. In matters of such weighty importance, isn't it a short-sighted policy that acts only for today and disregards tomorrow? Why should a measure that is ultimately detrimental in its effects be imposed on an entire country or state for the temporary relief of a condition that is local, and which should be remedied by prevention rather than cure? It should not be inferred from this that there are no poor in small communities; but the conditions are very different from those existing in large cities. Again, no measure of the magnitude and importance of compulsory health insurance, the effects of which are in any way doubtful, should be thrust on a people, for it is a well known fact that a principle once written into the law seldom becomes erased, and the baneful influence of such laws are cumulative, and eventually drag a people down." — C. K. Drinker.

Sickness Facts Indicate Urgent Need of Compulsory Health Insurance. *John E. Ransom.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 41–45. — Some of the interesting results of the study of the Illinois Health Insurance Commission are touched upon in this article. Of 4474 wage-earners, who played a part in the commission's investigations, 937, or 20.9 per cent., lost a week or more as a result of sickness. The average time loss of 901 of these cases was 7.35 weeks each, or 14.1 per cent. of the year. In the cases of 1667 families, sickness costs due to loss of wages and cost of medical service averaged $97.98 per family, and the cost burden was heaviest in the group receiving the lowest income. Among the group where there was a loss of at least a week's wages in the year, only 13.4 per cent. of the wage-earners received any sick benefits.

From these and other data, the writer concludes that:

1. The sickness problem is serious from the standpoint of loss of wages.

2. Sickness has grave social as well as economic aspects.

3. There is little insurance at the present time in Illinois which provides even partial indemnity for loss of wages, and there is practically none which provides medical care.

Just as workmen's compensation has led to a greatly increased interest in the safety movement, likewise universal health insurance will provide a powerful incentive to the prevention of disease. — C. H. Paull.

Life Insurance in its Relation to Thrift. *S. S. Huebner.* Ann. Am. Acad. Pol. Sc., Jan., 1920, 87, No. 176, 183–189. — The fundamental purpose of life insurance is pointed out as being the "capitalization of the value of human life," and through this means the protection of dependents or business interests against the loss of the value of that life through premature death. The writer advances the arguments in favor of life insurance under four headings:

1. Life insurance protects during the period when the individual is accumulating sufficient savings to guard dependents against his loss.

2. Life insurance is in itself a form of saving.

3. Life insurance involves regular and compulsory saving and is adapted to the saving of small sums. It stimulates the systematic laying aside of money.

4. Life insurance protects against the hazard of outliving one's income where policies are taken out on the "income plan." — C. H. Paull.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II AUGUST, 1920 NUMBER 4

CONTENTS

GENERAL

A UNIVERSITY COURSE IN INDUSTRIAL HYGIENE. *Robert T. Legge.* U. S. Pub. Health Ser., Pub. Health Rep., April 9, 1920, 35, No. 15, 891–893. — This article contains a syllabus of a lecture course in industrial hygiene as given at the University of California for the past six years. In order that the material may be grouped specifically, the subject matter of the course is treated in four parts as follows: (1) Temporary Industrial Centers: Mining, Lumber, Railroad, and Military Camps; (2) Factory and Occupational Hygiene; (3) Industrial Accidents and Safety Measures; and (4) Health Supervision, Welfare Work and Workmen's Compensation. The instruction is as practical and definite as it is possible to make it, fully illustrated by diagrams and lantern demonstrations, and is supplemented by visits to industrial plants for observation and criticism. — M. C. Shorley.

INDUSTRIAL HYGIENE: NEED OF RESEARCH IN CANADA. Prepared under the direction of the Committee on Industrial Fatigue. Pub. Health Jour., May, 1920, 11, No. 5, 216–220. — This article issued by a Canadian government committee is an official expression of Canadian recognition of the importance of industrial hygiene as a science based on the laws of physiology. After a brief survey of the present position of industrial hygiene, an account is given of the formation of the Committee on Industrial Fatigue — the name of which, since the issuance of this article, has been changed to Committee on Industrial Hygiene — and of the establishment of an intelligence bureau and library with offices in the Medical Building of the University of Toronto. The committee will be pleased to co-operate with similar bodies in other countries. Requests for information should be addressed either to the Chairman

(Professor J. J. R. Macleod) or to the Secretary, Committee on Industrial Fatigue, Medical Building, University of Toronto, Toronto. — R. M. Hutton.

Peace-Time Programme of the Red Cross Society. *J. G. Fitzgerald.* Medical Conference Held at Cannes, France, April 1 to 11, 1919 — Recommendations and Resolutions: Reports Adopted and Presented to the Conference by the Section on Venereal Diseases, the Section of Tuberculosis, and the Section of Child Welfare. Pub. Health Jour., April, 1920, 11, No. 4, 149–175. — At a conference held at Cannes in April, 1919, and attended by delegates from Great Britain, France, Italy, Japan, and the United States, the League of Red Cross Societies drew up a peace-time program with the following objects: "the improvement of health, the prevention of disease, and the mitigation of suffering throughout the world." The Medical Conference, held at the invitation of the Committee of Red Cross Societies, approved of the peace-time extension of the activities of the Red Cross Societies and recommended the establishment of a Bureau of Health and Advisory Council in connection with the League of National Red Cross Societies. Certain resolutions and memoranda unanimously adopted were submitted by the conference for the purpose of indicating in a general way some of the lines of activity which the Bureau of Health might follow. These resolutions deal, among other things, with the control of typhus fever, the extension of child welfare work, the encouragement of scientific investigation in hygiene and sanitary science, the promotion of efficient public health administration, and the general adoption of the program proposed by the conference for the control of tuberculosis, malaria and venereal diseases.

Attached to this paper are the reports adopted and presented to the Medical Conference by the Section on Venereal Diseases, the Section of Tuberculosis, and the Section of Child Welfare. — R. M. Hutton.

Need for Standards for Recording and Classifying Defects and Impairments. *John S. Billings.* Am. Jour. Pub. Health, May, 1920, 10, No. 5, 410–414. — An attempt has been made to show the needs for standard definitions of defects and impairments and the standard methods of classifying and tabulating them. Certain simple, somewhat arbitrary methods which have given satisfaction are described. The true object is to determine, not the total number of variations from the normal, but only those in which such variations really impair function.

Defects are defined as variations from the physical normal, which may or may not be impairments, either actual, potential or corrected. Impairments are defects which appreciably interfere with the proper performance of duty. Impairments well corrected, whether temporarily or permanently, are classified as defects for the time being. For the purpose of medical bookkeeping, only uncorrected impairments should be considered, and these should be classified as "correctable" or "non-correctable." These are tabulated on the basis of a standard classification under fifteen headings, and the severity is indicated by one or more plus signs.

The author suggests that this subject seems to be of sufficient importance to warrant a recommendation that a committee of the American Public Health Association be appointed to take up the matter in joint conference with a similar committee of the Association of Industrial Physicians, and to submit recommendations as to the best methods of securing uniform results. — H. F. Smyth.

Health Conservation Plan. Nat. Civic Federation Rev., April, 1920, 5, No. 2, 9. — The social insurance department of the National Civic Federation recommends that special state commissioners study the extent, cause, prevention and treatment of sickness, wage loss, replacement, and extension of public health education. — G. E. Partridge.

The Modern Social Hygiene Problem. *Edith Houghton Hooker.* Survey, March 6, 1920, 43, No. 19, 707–712. — It is pointed out in this article that the modern social hygiene problem includes the following elements: (1) education, (2) recreation, (3) medical treatment, (4) law enforcement. One of the most important factors of the educational program is complete and frank publicity regarding the sources of venereal infection, together with the results both to the individual and to those with whom he comes in contact. In order to counteract the recreational aspects of unwholesome amusement, adequate facilities should be available for young people to enjoy themselves in

the best environment. Medical treatment has most to do with existing cases of venereal infection. Not only should the prostitute be treated, but also those who patronize her. Proper local facilities should be established for listing all cases of infection, and these should be followed up until a cure is effected. The activities of authorities issuing marriage licenses should be so co-ordinated with the work of listing cases of venereal disease that marriage involving infected persons could be prevented. The objects of a law enforcement program are outlined as: (1) the standardization of human sexual contact; (2) the making of individuals responsible for sexual conduct; (3) the protection of young of both sexes from seduction; (4) the making of marriage "the sole condition on which the state will tolerate sex relationship."

Among the important points in the present program of the American Social Hygiene Association are the reduction of exploitation of prostitution from paying to non-paying enterprise, the protection of feebleminded and minors, and the holding of the man who pays responsible for his part in commercialized prostitution. — C. H. Paull.

Community Responsibility for Physical Inefficiency. Editorial. Am. Physical Education Rev., Feb., 1920, 25, No. 2, 69–72. — An investigation by Newman shows that 1,000,000 persons of school age in England are so defective as to be unable to derive reasonable benefit from the ordinary form of education. The loss suffered by English workmen from preventable illness is very large. — G. E. Partridge.

Problems of Physical Education. *D. Snedden.* School and Society, May 8, 1920, 11, No. 280, 541–550. — The contemporary movement for physical education, like the similar movement for universal vocational education, is the product of aspirations, originating in the last quarter of the nineteenth century, for human conservation and increased efficiency. Physical training has four distinct aims: (1) to promote physical development; (2) to correct specific physical defects; (3) to establish special forms of strength, agility, and skill for the vocational (including the military) needs of life; and (4) to establish special forms of interest, skill, etc., for the non-vocational (including the recreational) needs of life.

There has been too little appreciation of the physical requirements of modern vocations of the non-combatant type. Industry as well as war exacts heavy penalties of the physically unprepared. It is an important question whether "all round" development is the best preparation for all occupations. Indeed, the evidence in its favor is far from conclusive. The prevailing exactions of the vocations must be studied. Of a thousand boys in a suburban high school, it can safely be said that 75 per cent. will enter upon brain work rather than upon manual vocations. Such facts must be taken into consideration. The diagnosis of social situations will also help. We know that a large majority of middle class girls serve for several years in non-manual vocations, after which they become home makers. These vocations make peculiar demands upon health, and they should be prepared for.

The usual physical training that prepares for intensive activities of competitive games will not be a good foundation for meeting the vocational strains — that we can predict with certainty. On the other hand, training that would promote full functioning of the heart, lungs, skin, kidneys, etc., and which would encourage motor poise might be of the utmost service. Prolonged but not arduous physical work might be one of the best means of preparation. Each vocation should be studied with a view to answering the following questions: (1) What are the physical strains it imposes? (2) How far can we prevent the most poorly adapted from entering upon it? (3) What specific training can we give against these needs? (4) What are the recreations that are (a) feasible and (b) desirable for the workers in this vocation? and (5) What training can we give that will produce interests and powers for suitable recreations offsetting the strains? — G. E. Partridge.

The Need for Vocational Guidance in Colleges. *J. M. Brewer.* School and Society, May 1, 1920, 11, No. 279, 511–517. — Vocational guidance can be conceived of as expressing itself in two ways: first, in equipping communities with the knowledge of occupational problems which is necessary for their civic well-being; and, second, in furnishing each individual with the skill he needs to guide his own personal destinies in the occupational world. Rightly conducted in either direction, vocational guidance will serve the other.

At the present time, vocational guidance finds itself handicapped by an educational dualism that makes a distinction between culture and the practical life. It is distrusted by the college faculty because it is feared that the student who thinks about his future work will be likely to choose his courses with that work in mind. In reality, it is vocational *education* that is feared by the college, and the counsellor joins the professors of the standard subjects in the belief that actual vocational education should be delayed. The vocational expert, however, does not fear that the student who thinks about his future will try to avoid breadth of education. In fact, it is found that even persons in the commoner occupations, once their pressing economic problems are solved, often reach out for cultural forms of education.

In concluding, the author makes the following recommendations: (1) A broad and cultural vocational guidance in college should provide the opportunity for the student to try his powers against a varied curriculum which relates itself directly to many occupational activities; (2) the college must give the student a better opportunity to study the occupational world; (3) the college student needs better guidance in choosing his calling, and the choice of an occupation can best be made by progressive elimination; and (4) if vocational courses are offered, guidance must accompany them. — G. E. Partridge.

Community Organization for Vocational Guidance. Report of the Committee to the National Vocational Association of the United States. Education, March, 1920, 40, No. 7, 447–452. — The writer urges the having of an ideal toward which to work. We need complete and detailed school census, showing attendance records; there should be psychological tests (which do not determine the abilities of individuals so well as they point out the educational needs of the specific group); there should be school scholarships, physical examinations, social case work, better administration of child labor laws, industrial surveys, educational and vocational guidance, placement, follow-up guidance. The first step for any city to take is to make a proper survey. The second step is to organize the work, if nothing further is done than to establish a central committee. — G. E. Partridge.

A Unique Plan in Vocational Education. *W. T. Carrington.* School and Society, April 24, 1920, 11, No. 278, 501–502. — The State Department of Vocational Education in Iowa, in co-operation with Kansas and Oklahoma, has planned a unique piece of trade education for men and apprentices in the Joplin mining district. Courses will be offered to foremen for the purpose of training them to teach the men under them while engaged in the work. It is argued that there is no other way of reaching a large number of men in the class of unskilled workmen. Plans for similar work in teaching home-making and also in agricultural education are proposed. The whole plan is to utilize the *best* in any trade, in any community, or in any group having similar intents and purposes, as instructors of others who have the same or similar problems. It is a process of building up from within rather than from without. — G. E. Partridge.

Eyesight in Connection with Education. *J. Kerr.* School Hygiene, Nov., 1919, 10, No. 3, 116–126. — This is a study of requirements for examination, criticism of methods, etc., and is useful from the point of view of the industrial hygienist. — G. E. Partridge.

The Dope Doctor. *Thomas S. Blair.* Survey, April 3, 1920, 44, No. 1, 16–20. — The writer reviews present conditions and tendencies in the prescribing and use of narcotics. Although there has been a marked dropping off in the harmful sale of narcotics since the passing of the Harrison Narcotic Law in 1915, it is still possible for many people addicted to the use of narcotics to obtain a certain amount. The obvious result of the passage of the Harrison Law is shown in the following figures for imports of narcotics. In 1915 there were imported into the United States 484,027 pounds of standard opium; in 1916, 146,658 pounds; and in 1917, 86,812 pounds.

The writer is convinced that at the present time "the dope-selling professional man is the main narcotic menace in this country." He bases this statement upon careful study which has brought him into contact with all sorts of illicit trade in narcotics. Frequently the professional dispenser of narcotics is of the old school and does not see the danger which is obvious to younger men in the profession. This fact coupled with a certain kind-hearted weakness has often made a respected practitioner a definite menace to the best interests of the community in which he lived. — C. H. Paull.

The Increased Incidence of Cocainism in Berlin. *Bruno Glaserfeld*. Deutsch. med. Wchnschr., Feb. 12, 1920, 46, No. 7, 185–186. — Before the war, the cocain habit was of small consequence in Germany as compared to the morphin habit. Lately, however, cocainism is more commonly seen, especially among returned soldiers. The author briefly describes an "underground" system of illicit drug traffic, by means of "wires" or pedlers, which is almost comparable to that with which we are already only too familiar in this country. He favors more stringent enforcement of the present laws regulating dispensing, although it is hard to see just how this will eliminate illicit traffic. — T. J. Putnam.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

The Importance of Tellurium as a Health Hazard in Industry — A Preliminary Report. *Marvin D. Shie* and *Forrest E. Deeds*. U. S. Pub. Health Ser., Pub. Health Rep., April 16, 1920, 35, No. 16, 939–954. — Incident to the increased production of tellurium it is reasonable to suppose that we shall encounter an increasing health hazard due to the more frequent exposure of the workers. This article takes up the manner of exposure, the mode of entering the body, the early symptoms of tellurium absorption, diagnosis, preventive measures, treatment, and the progress being made in laboratory work on this subject. The data presented were afforded by the study of seven men employed in a silver refinery. — L. A. Shaw.

The Danger of Carbon Monoxide in the Burning of Charcoal. *H. Selter* and *Frankenstein*. Abstracted from Gesundh. Ing., 41, 126–127; and Chem. Zentr., 1918, 2, 59, by F. W. Tanner in Chem. Abstr., April 20, 1920, 14, No. 8, 1176. — "Contrary to the statements of von Recknagel, there is serious danger in burning charcoal in a room without a chimney. No difference in the amt. of CO formed in a room was found whether charcoal was brought into the room lighted or was kindled in the room. In both cases the amt. of CO formed was such that it might be a serious danger to health." — W. O. Fenn.

Poisoning by Barium Carbonate. *Adolph Mayrhofer* and *Karl Meixner*. Wien. klin. Wchnschr., Oct. 30, 1919, 32, No. 44, 1068. — A case of accidental or suicidal poisoning with rat poison containing barium carbonate. The most characteristic symptom was the marked progressive weakening of the lower limbs. The barium salts affected mainly the smooth musculature in the body. Consciousness remained clear to the end. The danger is pointed out of mistakenly using a hydrochloric acid-soluble salt of barium for the sulphate or for bismuth in radiography. A review of the literature on barium poisoning is included. — Barnett Cohen.

Poisoning by Alcohol "Denatured" with Nitrobenzene. *R. W. Scott* and *P. J. Hanzlik*. Jour. Am. Med. Assn., April 10, 1920, 74, No. 15, 1000. — "During the last Christmas holiday season a large number of dark, ghastly looking patients who had been drinking 'denatured alcohol' were brought into the City Hospital within a few days. As a rule they were unconscious. The dark, almost black, discoloration was limited mainly to the extremities, face and neck, including a fringe of the upper portion of the chest. In other words, the richly vascular, pigmented and dependent portions of the body were principally involved. The color was not the typical blue of ordinary cyanosis, but rather a livid, brown-black or nearly black, suggesting the presence of methemoglobin in the blood. Except for the deep narcosis and a moderately rapid pulse, the patients were otherwise practically normal. No other circulatory and no respiratory disturbances were detectable. After a deep sleep of about twenty-four hours, the patients left the hospital fully recovered. They did not seem to suffer, and there were no fatalities."

"Acute poisoning by alcohol 'denatured' with nitrobenzene, and containing a low concentration of formaldehyd, occurred in a number of cases. Although apparently low grade and nonfatal, there is considerable potential harm from such beverages when used over long periods, confusing at the same time the diagnosis of minor maladies." — C. K. Drinker.

A Coating for Poison Tablets for the Prevention of Accidental Poisoning. *Gray Phillips.* Mod. Med., Feb., 1920, 2, No. 2, 155–156. — A coating of wax has been tested as a means of preventing accidental poisoning from the swallowing of poison tablets; these tests show that tablets properly coated with wax will be recovered intact in the feces, thus resisting solution in the digestive fluids of the body. — L. Greenburg.

Rapid Method of Estimating Lead in Cassia Oil. *O. F. Lubatti.* Jour. Soc. Chem. Indust., Feb. 16, 1920, 39, No. 3, 35–36T. — A colorimetric method for determining lead (as sulphide) in cassia oil. Cassia oil is exported from China in lead cans, and contains 0.04 to 0.06 per cent. of lead. The maximum amount of lead taken up by oil in contact with the metal is 0.074 per cent. — C. H. Fiske.

DUST HAZARDS AND THEIR EFFECTS

Pulmonary Disease among Rope Workers. *Erich Ebstein.* Zentralbl. f. Gewerbehyg., Jan., 1920, 8, No. 1, 20–21. — Bernadino Ramazzini (1633–1714) recognized the danger to which workers in hemp and flax are exposed by inhalation of dust. Morgagni (1682–1771) performed autopsies on five persons engaged in this industry and observed inflammatory changes in their lungs. Morgagni and Ramazzini concluded that the persistent cough and asthma met with in hemp workers were directly attributable to the inhalation of dust. Hirt, in an investigation in 1871, states that 42.3 per cent. of all the sickness among such workers was of a pulmonary character. Koelsch claims that the hazard in the hemp industry is due mainly to the inhalation of hemp dust which produces cough, fever, and bronchial catarrh. Those engaging in this industry should be free from tuberculosis, nasal obstruction, flatfoot and varicosities. It is particularly important that these workers should not be mouth breathers. The greatest preventive measure against the pulmonary symptoms is thorough ventilation of the workrooms. — G. B. Wislocki.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Efficacy of Normal Serum in Anthrax. *F. v. Hutyra* and *R. Manninger.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1919, 83, p. 518. — Sera of normal horses, cattle or sheep fail to protect young rabbits against a subcutaneous injection of virulent anthrax bacilli, whereas immune sera protect satisfactorily. So-called normal sera, which are sometimes found to have a protective power, are probably the result of a latent, unsuspected infection in the animals from which they are derived. — Barnett Cohen.

The Blood Picture in Typhoid Carriers. *Gerhard Wodtke.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1920, 84, p. 114. — The blood picture of the typhoid carrier is characteristically influenced by the toxin. There is a relative neutropenia and a considerable relative lymphocytosis, both of which are due to the action of the typhoid toxin as in the acute disease. Examination of the leucocyte picture may therefore be of value in the search for carriers. — Barnett Cohen.

Control of Typhoid Carriers by Examination of the Duodenal Juice. *Friedrich Schuman-Leclercq.* Wien. klin. Wchnschr., Oct. 30, 1919, 32, No. 44, 1074. — Bacteriological examination of the duodenal juice is necessary in addition to that of the stools and urine to pronounce a typhoid convalescent or carrier free from Bacillus typhi. The duodenal sound provides a ready means for securing the duodenal contents for such examination. — Barnett Cohen.

Etiology of Spanish Influenza. *C. J. C. van Hoogenhuijze.* Centralbl. f. Bakteriol., 1te Abt., Orig., 1920, 84, p. 88. — A bacillus, not quite like the Pfeiffer bacillus, was isolated from the blood of thirty-four cases and successfully cultivated on blood medium. This organism gave specific serologic reactions. It is

not pathogenic for laboratory animals. Inoculation experiments on man were not performed, but since this organism was found in the blood of numerous influenza patients early in the disease, and not in other cases, it is concluded that this was the etiological agent in the disease. — Barnett Cohen.

Pulmonary Tuberculosis in the Army. *Alexander Engel.* Wien. klin. Wchnschr., 1920, 33, p. 40. — Three-quarters of the German soldiers who were affected with pulmonary tuberculosis entered the army in good health, and of these, 80 per cent. contracted the disease in the field. Of the other quarter, who were sick on entering the army, 60 per cent. suffered an aggravation of the disease during military service. — Barnett Cohen.

Quinine Methylene-Blue Therapy in Malaria. *Rudolf Reitter.* Wien. klin. Wchnschr., 1920, 33, p. 9. — Methylene-blue alone is not effective in the treatment of malaria. However, in quinine-resisting cases (those that do not respond to quinine treatment) administration of methylene blue is successful against malaria. — Barnett Cohen.

Therapy in Ringworm Infection. *O. Sachs.* Wien. klin. Wchnschr., Dec. 18, 1919, 32, No. 51. — In superficial infections, simultaneous applications of tincture of iodine and ointment of ammoniated mercury are effective. In deep-seated infections, intravenous injection of 4 to 14 grams of urotropin in 40 per cent. solution is without danger and yields good results. — Barnett Cohen.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

The Alteration in Twilight Vision in Occupational Nystagmus. *L. Weekers.* Bull. Acad. Méd. Belgique, Sept., 1919, 29, No. 7, 1268–1276. — It is well known that hemeralopia (day-blindness) occurs independently from any ocular disease in cases of denutrition and fatigue. Dr. Weekers found at the ophthalmological clinic he had at the Belgian front that 9 per cent. of his cases were affected with hemeralopia, which he studied graphically with Nagel's adaptometer. Several facts pointed to fatigue as the origin of the trouble: the greatest proportion of cases belonged to the infantry, and were observed during the first year of the war, at a time when the Belgian army had made a continuous and desperate effort and when equipment was so deficient that many soldiers had to walk to the trenches in wooden shoes or even with no shoes at all. When in later years the army was re-equipped and the strain to which it was submitted lessened, the proportion of hemeralopia cases fell to 3 per cent.

Dr. Weekers thinks that these facts have to be taken into account in the explanation of miners' nystagmus, which he considers originates from several causes acting together: deficient illumination, overwork, cramped position, abnormal conditions in binocular vision, etc. — René Sand.

The Protection of Workmen against Injurious Lubricating Agents. *H. Fr. Ziegler.* Zentralbl. f. Gewerbehygiene, Jan., 1920, 8, No. 1, 11–14. — The necessity of using substitutes in Germany during the war led to the production and sale of a variety of lubricating substances which were injurious to health. These contained principally alkalies, tar oils and nitro compounds which irritated and injured the mucous membranes of the eyes, nose, throat, mouth and lower respiratory passages as well as oftentimes the skin itself. The writer advocates the passage of laws prohibiting the manufacture of injurious lubricants. He believes that these substances should conform to a certain standard which he defines by the following rules: The lubricant should be free from resins and acids. It should prevent rusting and not cause it. It should not possess a large quantity of insoluble ingredients which eventually clog the machinery, pumps, etc. It should not produce disagreeable odors. It should not attack metal, wood, leather or clothing. It should not be irritating to living tissue, nor produce eruptions of the skin, nor be injurious to small cuts or abrasions. — G. B. Wislocki.

Sweat-Band Burns of the Forehead among the Police of Königsberg. *Schemel.* München. med. Wchnschr., June 11, 1920, 67, No. 24, 700. — Thirty cases of burning and irritation of the skin of the forehead, and in a few cases of the hair-covered portions of the temples, resulted from wearing caps presumably with leather substitute sweat bands. The symptoms were a simple inflammatory reddening of the skin similar to a diffuse nascent eczema. One case, after three days, showed typical symptoms of herpes zoster. — M. D. Ring.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

A New Plan of Accident Control. *David S. Beyer*. Safety Engin., April, 1920, 39, No. 4, 173–178. — Salesmanship is as necessary to the success of an accident prevention campaign in an industrial plant as it is to the success of any new proposition. A formula that is used in putting through the safety idea successfully is: (1) Get the attention of the manager by showing what accident prevention really means to a plant; (2) arouse his interest and convince him that he has such a problem by putting his own accident record before him in such a way that he will understand it and will compare it with the records of other plants in similar industries; (3) develop his desire for accident prevention by charts made up according to a standard method; and (4) get him to act. This result generally follows automatically from the use of charts. As soon as the management of a plant is shown that it is having a serious accident loss — particularly if its accident rate is higher than that of other plants in the same industry — action usually follows as a matter of course. Incidentally, from the standpoint of the employer, there is a legitimate satisfaction in the fact that where safety work is kept up for a period of years the insurance premium has been cut by 20, 30, 40, and even 50 per cent. of the average rate for his industry. — R. Thomson.

Work, Fatigue and Accidents. *Ernst Guth*. Zentralbl. f. Gewerbehygiene, Jan., 1920, 8, No. 1, 1–7. — The writer concludes from a statistical investigation that:

1. A connection exists between industrial work and accidents since the number of accidents increases with the speed of production. The curve of accidents rises much faster than that of work. This is due to the preponderance of minor injuries.

2. The effect of fatigue is recognizable by the increasing number of severe accidents toward the end of the period of work.

3. The fact that severe injuries occur more frequently during the last hours of work, coupled with decreased intensity of production during this period, indicates that a reduction of working hours would be advantageous not only to the workers but to the employer as well.

4. The physical, mental, and moral qualities of the individual are an important factor in industrial accidents. Consequently, hygiene should be considered an important measure in preventing accidents. — G. B. Wislocki.

The Psychoneurotic Effects of Accidents. *Martin Reichardt*. Deutsch. med. Wchnschr., Jan. 22, 1920, 46, No. 4, 89–92. — "1. Occupational and railway accidents can cause no lasting wage-earning disability, in so far as their psychic effect is considered, unless organic disease changes are instituted or made worse. In particular, they can cause no long-lasting psychoneuroses. Only individual reactions in the psychic sphere can arise after accidents, which, except for the emotion of fear, have a more or less psychopathic tendency as a starting point. The prognosis of these psychotic individual reactions to the accident is therefore favorable. Acute and even somatic symptoms are characteristic of the fright reactions, emotion, and psychic shock. The greatest dependence is to be laid upon the presence or absence of these acute symptoms, especially those of a somatic nature. The more pronounced the acute symptoms immediately after the accident and the more a typically psychotic clinical picture is established, the longer are the effects of the accident to be expected to last. By far the majority of fright emotions disappear in four weeks. Fear neuroses of more than a half year's duration do not occur in civil accidents.

"2. In particular, there are no true traumatic neuroses, accident neuroses, traumatic neurasthenias, or traumatic hysterias in the literal sense, lasting for years. The longer a purely functional psychoneurosis, apparent or real, lasts after an accident, the more is it to be predicated that the accident cannot be the cause of it. This is especially true if the disturbance is of long standing and has progressively increased, and if striking, acute, somatic symptoms in the sense of shock have been lacking. All long-lasting psychoneurotic disturbances without very striking acute symptoms may be separated at once from the effects of accidents. But even when there has been shock in the first place, long-lasting psychoneurotic conditions without objective anatomical or somatic symptoms are usually not the result of accidents.

"3. In regard to the psychoneurotic symp-

toms which arise coincidently with accidents covered by insurance, psychological and psychopathological analysis is not alone necessary. It is essential to inquire thoroughly whether they are to be considered as consequences of the accident. . . . A large proportion of the psychoneuroses formerly considered traumatic have actually nothing to do with the accident. Such derangements usually develop slowly by themselves, coincidently with the injury, without acute symptoms; they therefore preserve their thought-method and content in spite of the accident. But the greater number of the so-called traumatic neuroses in the older sense are psychological or psychopathic reactions to the insurance proceedings. These may also have the characteristic slow progressive course, while the real traumatic derangements of a psychic nature are regressive.

"4. Whether the so-called 'insurance neuroses' are fundamentally the results of an accident, is properly a judicial question. The judgment of the highest authorities should here lead to a unified opinion. The present psychological view of the nature of the 'insurance neurosis' would be adequate, if the individual or psychopathic reactions to the insurance proceedings were not considered as consequences of the accident covered by the insurance. By this means would the struggle against the 'insurance neurosis' be most suitably carried on, and it would be forestalled at the earliest possible moment (prophylactic treatment of the 'insurance neurosis'; appropriate education of the psychopath). To be sure, definite legal powers would be necessary. From the medical standpoint, only a very small proportion of the 'insurance neurotics' are really damaged in earning power. So the medical profession should not be too softhearted. In the majority of cases it is a question of suggested symptoms, hypochondriacal ideas, querulent reactions, will-defects, hysterical or conscious exaggerations and simulations, which still fall within the realm of normal psychology, and do not lead to any definite disability. An appreciable proportion of people with psychopathic reactions to the insurance proceedings should still, however, be regarded as sick from the medical standpoint. Among these belong, in the first place, those with pronounced lasting, and evidently abnormal somatic symptoms, not merely the simple sensations formerly called bodily symptoms. As long as these are evidently reactions to the insurance proceedings of a hysterical, hypochrondriacal, or purely suggested nature, they are fundamentally adapted to compulsory medical (psychotherapeutic) treatment. The possibility of such compulsory treatment for an indefinite time, until the patient is well, must be legally established, if the psychopathic reaction to the insurance proceedings be recognised as a consequence of the accident. . . .

"5. It is extremely necessary that the medical profession should come to a fundamentally unified view of the nature of psychoneurotic symptoms following accidents to insured persons. The profession must stand together in the struggle against psychopathic reactions to insurance proceedings. . . . The experience of the war, the extraordinarily great resistance of the human brain against psychic influences, the slight etiological rôle which is played by single psychical incidents in the sense of injuries, all show the way by which a unified comprehension of these 'social neuroses' is obtainable." — T. J. Putnam.

Air Conditioning Prevents Explosions Ignited by Static Electricity. Chem. and Metall. Engin., March 31, 1920, 22, No. 13, 614. — Plants handling quantities of chemicals can be protected against chance explosions due to static electricity by a proper modification of the factory air. Dry air increases the possibility of static discharge. — G. M. Fair.

A Man at the Bench Is Worth Ten in the Hospital. *James A. Reed.* Factory, April 15, 1920, 24, No. 7, 1141–1144. — The somewhat unusual experience of the Mare Island Navy Yard in reducing accidents is briefly discussed in this article. In spite of an increase in the working force from 3651 to 9500 employees, it was possible to reduce the number of accidents materially in a period of twenty-six months between July, 1917, and September, 1919. The rate fell from 1.26 accidents per 100 employees to 0.35.

Although a safety committee had been in existence for some time at the Navy Yard, its work had not included campaign activities and advertising. With the advent of a safety engineer, a thorough scheme of publicity was introduced. Safety bulletins were located at strategic points, suggestion boxes were put up, and employees encouraged to make contributions. A system of safety guards was organized. These safety guards were men selected for their

special ability. They were given authority to caution and direct fellow-workers who were indulging in unsafe practices. Similar precautions were taken in the case of fire, and a brigade of rescue men was organized. — C. H. Paull.

Some Recent Improvements in Miners' Electric Lamps. *William Maurice.* Tr. Institution Mining Engineers, March, 1920, 59, Part I, 2–19. — A description of the latest developments in the design of electric lamps for mine workers. — G. M. Fair.

INDUSTRIAL SURGERY

The Technic of Nerve Suture. *Byron Stookey.* Jour. Am. Med. Assn., May 15, 1920, 74, No. 20, 1380–1385. — A general summary description of the author's methods for handling problems of nerve suture in different parts of the body. — C. K. Drinker.

The Treatment of Injuries to Athletes. *Harry Eaton Stewart.* Jour. Am. Med. Assn., April 3, 1920, 74, No. 14, 947–948. — The application of methods of physiotherapy tested out in the army and Public Health Service hospitals has proved very useful in injuries sustained in the "vigorous fighting games of youth." Stewart describes methods of treatment used in the following classes of injuries, all of which occur rather prominently in industrial practice:

1. Muscle bruise. — Relaxation, firm bandaging and rest for twenty-four hours at the end of which time baking or, better, high frequency current may be used. Massage is begun upon the second or third day.
2. Torn ligaments. — Relaxation, partial protection, guarded but constant use.
3. Torn muscle insertions. — Complete relaxation for two weeks then guarded use, care being taken not to tear away the newly formed muscle attachment.
4. Subperiosteal hematoma.—Rest and firm bandaging followed by the use of heat and massage.
5. Tenosynovitis. —If acute, absolute rest, heat and gentle stroking, with more prolonged and intense heat and massage later. — C. K. Drinker.

Infections of the Upper Extremities. *P. A. Bendixen.* U. S. Bur. Labor Statis., Month. Labor Rev., Nov., 1919, 9, No. 5, 327–335. — In this brief paper read at the sixth annual meeting of the International Association of Industrial Accident Boards and Commissions, held at Toronto, Canada, Sept. 23–26, 1919, the writer gives a general survey of the causes and treatment of infections of the upper extremities. He believes that "90 per cent. of the arms, hands, and fingers could be saved if care and judgment were used in the proper handling and management of these cases." The writer's statistics are based on his personal observation, during the years 1917 and 1918, of 1696 injuries to the upper extremity. — R. B. Crain.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Prevention of Fatigue in Industry — III. Reduction of Necessary Fatigue. *Reynold A. Spaeth.* Ind. Management, March, 1920, 59, No. 3, 215–217. — The writer points out that without altering a job in any way it is possible to reduce the fatigue involved in it by making a careful selection of workers with adequate resisting powers. To determine who these workers shall be involves careful physical, physiological, and psychological analysis to fix standards in the case of specific jobs.

Among the first questions which arise is that of muscular exertion required in a job. The spring balance method of Lovett and Martin is recommended because of the simplicity of the apparatus required and the ease with which the test can be given.

In determining physiological efficiency, a test based upon variation in blood pressure and heart action after exertion is effective. Dr. Crampton has outlined the procedure and method of using data in such a test. His rating table is reproduced. Up to the present time no satisfactory endurance test has been devised.

The writer suggests, however, that a definite correlation may be found between physiological efficiency and endurance.

One of the most important elements in developing fatigue tests is to make both management and worker appreciate the practical and personal value of such tests. Unfortunately, the medical examination has in some cases fallen into disrepute among workers, because it has been used for illegitimate ends. Only by the most intelligent and sincere presentation of the case of fatigue tests will their real significance be understood. — C. H. Paull.

A New Method for the Diagnosis of Fatigue Following Muscular Effort, the Palmograph. *Ernst Brezina.* Arch. f. Hyg., 1920, 89, Nos. 1, 2, and 3, 1–26. — The author describes a simply constructed apparatus which registers as deviations from a horizontal line all tremors of a subject's hand as he attempts to make contact between a copper tipped pencil and a metal plate in the bottom of a small circular opening in a vertical plate. This makes a permanent record or curve on a revolving drum. Various factors as to time, extent and number of the deviations were studied and the average sum of the maximum vertical deviations in a series of ten to twenty-five tests was taken as the factor giving the greatest amount of information.

Among the conclusions reached after an extended study of the method on various test subjects are the following:

No subjects give a straight line curve with no evidence of tremors.

Exhausting bodily effort increases the extent of the deviations to a greater or less degree not always proportional to the amount of work done.

Intensive effort for short periods is followed by a rapidly developing increase in the curve with a quick subsidence to normal.

Continued severe industrial effort over long periods (a year or more) produces continued increase in the extent of the deviations which may be further temporarily increased by added acute effort.

Subjective fatigue sensations show no definite relation to the curves developed by the palmograph.

It is hoped that further study may show a definite relation between increase in the deviation curves and the development of chronic fatigue. — H. F. Smyth.

The Influence of the Week on the Ebb of Human Energy. *Ernst Brezina.* Arch. f. Hyg., 1920, 89, Nos. 1, 2, and 3, 27–46. — This paper is a statement, based on statistical studies on schoolchildren and adults, of the value of a weekly rest day in overcoming the cumulative effects of fatigue from the daily tasks, provided the rest period does not include an increased indulgence in alcoholic liquors.

The author advocates an attempt to encourage among workers a better method of employing the week-end rest period rather by example, education, and direction than by legal restraints. — H. F. Smyth.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION. ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

The Sanitation of Factories for Chemical Products. *Paul Razous.* Abstracted from Indnstrie chimique, 1919, 6, 329–332, by L. G. Smith in Chem. Abstr., May 10, 1920, 14, No. 9, 1401. — "In this paper R. discusses methods of sanitation under the head of methods of protection against factory dust, vapors and moisture, contact with irritating and caustic materials; numerous devices used to obtain these results are described. For fine dust of oxides, sulphates, sulphides, obtained from roasting or treating ores of silver, tin, copper, lead, zinc, etc., the electrical pptn. method operated under the Cottrell patents has been very successful. The drying of air by H_2SO_4, CaO and $CaCl_2$ is discussed and the qualities of these three are compared in regard to power of absorption of water vapor, and convenience. Power ventilation, with control of humidity by temp. regulation and adjustment to meet weather or seasonal conditions, are recommended. A diagram of a shop equipped to eliminate moisture or fog is given. Operations which produce large amts. of moisture in the air are gathered into one room. Openings direct into the outside air are closed. The roof is double, with an insulating air space of 35 cm. The room is 5 M. high. Air is conveyed from a neighboring place through a wooden duct heated by steam pipes, which can be closely regulated by the adjust-

ment of hand valves. There are numerous small rectangular openings in this wooden duct running around room, just above the dye baths. The openings are horizontal and are controlled by valves or flaps swinging on a horizontal axis, driving the incoming current of air upwards toward the ceiling or downward towards the floor. A large part of the rest of this article is devoted to the description of devices for raising, conveying, and manipulating corrosive liquids. The pumps, elevators, injectors, and siphons described are the same in principle, if not in pattern, as the devices used for similar purposes in this country." — W. O. Fenn.

Fundamental Principles of Illuminating Design — II. Light Distribution. Am. Arch., April 15, 1920, 117, No. 2312, 479–481. — A discussion of the theory of light reflection, diffusion, and refraction, and its application to illuminating design. Tables of coefficients of light utilization and technical data on Mazda lamps are given. — G. M. Fair.

Proper Illumination a Factor in Increased Production. *Otis L. Johnson.* Electrical Rev. (Chicago), May 8, 1920, 76, No. 19, 761–763. — Proper selection, location, and use of lamps and reflectors tend to increase the efficiency and morale of workmen, to decrease waste and spoilage of materials, and thus to increase production. — G. M. Fair.

Relation of Electric Lighting to Safety. *A. B. Oday.* Electrical Rev. (Chicago), May 8, 1920, 76, No. 19, 764–766. — A discussion of the magnitude of the safety question, including statistics of accidents and the influence of lighting in affording safety in industrial plant operations and in the streets. — G. M. Fair.

Recent Advances in the Science of Ventilation from the Industrial Standpoint. *George G. Nasmith.* Pub. Health Jour., May, 1920, 11, No. 5, 197–206. — This article, based on the fact that air temperature and air humidity have profound effects on the human organism, is an argument for the establishment of efficient ventilation systems in industries. The writer refers to the development in the knowledge of ventilation made during the past few years. In particular, he quotes the findings of Paul in 1905, which have since been confirmed by numerous other scientists, namely, that "the symptoms arising in vitiated atmospheres are due to heat stagnation in the body, and the moisture of the atmosphere, its temperature and its stillness are responsible for the effects produced."

From the results of various investigations and experiments it has been found that "in general a moderately cool and moderately dry air in motion is the most beneficial to the human body. A temperature of from 65 to 68 degrees Fahrenheit, with a relative humidity of not more than 50 per cent., is about the best where great physical labor does not occur."

The ideal system of ventilation should accomplish the following: "It should first of all maintain the air at a proper temperature and humidity; it should keep the air in gentle motion; it should remove odors, bacteria, dust and other contaminating substances, such as gases, and should provide a sufficient quantity of fresh air to remove all products of respiration." Looking at the matter from the commercial point of view, on the basis that better health means greater output, the writer considers that "it would probably pay well to install in almost every new factory the most modern ventilating system and employ an up-to-date engineer at the single task of watching the ventilation with the efficiency of the worker in mind." — R. M. Hutton.

Solution of Lead in Drinking Water. *Alberto Scala.* Ann. d'ig., Jan., 1920, 30, No. 1, 35–44. — A necessary condition for the solution of the lead is that the water contain mineral or organic acids, while the corrosion is due to the free oxygen contained in the water. Waters containing certain salts in solution have an inhibitory action on the solution of the lead. A 0.25 per cent. solution of potassium nitrate will prevent the lead hydroxide formed on the surface of a lead sheet of 33.04 sq. cm. immersed in 100 c.c. of the solution from passing into solution in the water. Ammonium nitrate, on the contrary, will favor the corrosion of the solution of lead hydroxide in the water. The action of the oxygen in the corrosion of the lead may be expressed by the formula:

$$Pb + 2H_2O \rightleftarrows Pb\begin{matrix} \diagup OH' - H' \\ \diagdown OH' - H' \end{matrix} + O \leftarrow Pb\begin{matrix} \diagup HO \\ \diagdown HO \end{matrix} + H_2O.$$

— E. Ciampolini.

The Action of Water on Lead. *J. F. Liversege* and *A. W. Knapp.* Jour. Soc. Chem. Indust., Feb. 16, 1920, 39, No. 3, 27–33T. — Three varieties of action of water on lead are

distinguished: (1) erosion (the formation of a flocculent precipitate, leaving a bright lead surface); (2) corrosion (the irregular appearance of a white crust); and (3) the formation of a dull whitish protective coating. Erosion occurs in the presence of oxygen when the alkalinity of the water is between 0.2 and 1.5 (parts of $CaCO_3$ per 100,000 of water); corrosion occurs when the alkalinity is between 1.5 and 2.5; when the alkalinity is greater than 2.5, a protective coating is formed. Erosion was measured by immersing bright lead strips in water, under standard conditions, for one day and estimating the lead removed from the surface by colorimetric determination as sulphide. Erosion is due to the action of oxygen, and is limited by the amount of oxygen in the water, besides being diminished by the presence of alkali (two parts of calcium bicarbonate per 100,000 prevent it). Erosion occurs in the absence of bacteria, and in the absence of CO_2. The presence of 1 or 2 per cent. of CO_2 causes a sudden change from erosion to plumbo-solvency. — C. H. Fiske.

Operating Experiences with Activated Sludge Process for Factory Wastes. *George W. Fuller.* Canad. Engineer, April 8, 1920, 38, No. 15, 367–368. — A novel method of adapting the activated sludge process to local conditions has resulted in securing satisfactory results in the treatment of industrial wastes from a plant for the refining of cocoanut oil and the manufacture of cooking oil, soap bases, and butter from cocoanut oil and milk products. Mr. Fuller has taken Mohammed to the mountain by supplying sludge to wastes which would not produce any themselves, thereby clarifying a liquid which could not be treated satisfactorily by other methods. — G. M. Fair.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Medical Service in Hotels. *E. M. Statler.* Mod. Med., Feb., 1920, 2, No. 2, 102–103. — A description of the medical department of the Hotel Pennsylvania which consists of an operating room, emergency ward, X-ray room, pathological laboratory, and a special treatment room for eye, ear, nose and throat work. Separate consultation rooms are provided for employees and guests. The medical staff consists of a full-time and a part-time physician, and a nurse. A two-hour daily clinic is held for employees, which takes care of an average of fifty to sixty cases daily. — L. Greenburg.

Dental Division of the Metropolitan Life Insurance Company. *T. P. Hyatt.* Mod. Med., March, 1920, 2, No. 3, 237–240. — The author discusses the results of the operation of the company's dental department for the past five years. The results of the operation of the prophylactic station have been so encouraging that every Home Office employee will henceforth be required to undergo examination and cleansing of the teeth twice each year. While this is not a statistical paper, statistics are quoted, however, which tend to show the enormous effect of dental conditions on systemic conditions. Record cards for dental examinations are shown which should prove of considerable value to industrial dentists. — L. Greenburg.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Preventable Death in Cotton Manufacturing Industry. *Arthur Reed Perry.* U. S. Dept. Labor, Bur. Labor Statis., Bull. 251, Oct., 1919, pp. 534. — This is a report upon the death hazard and contributory factors among the workers of a large cotton manufacturing center. Fall River was chosen as an especially appropriate field for such an investigation. The study emphasizes the death-rate method as yielding much more reliable evidence of hazardous conditions than any possible estimates of morbidity rates. Attention is called to a common fallacy in similar studies which often neglect non-casualty deaths.

The period covered by this investigation includes the five years from 1908 to 1912, inclusive. Data for operatives are drawn from scheduled information specially obtained from the cotton mill employees of Fall River, and from Fall River death records for the same period. Information respecting the total Fall River population is taken from the federal

census records. To insure valid comparisons, adjusted death rates only are used in the final reports.

In the body of the report appears a detailed study of mortality in a variety of relations, by age groups, sex, nativity, race, conjugal condition and special industrial factors including the principal jobs represented by the cotton manufacturing industry. Mortality is presented also in its relations with a variety of specific causes embracing both accidental violence and disease. Special attention is given to deaths from tuberculosis and parturition. Comparisons are made throughout between corresponding operative and non-operative mortalities.

A final portion of the discussion is devoted to contributory causes, such as alcoholic addiction, tuberculous kindred, unhygienic dwellings, low income, overwork, profligacy, and poor heredity. Supplementary to the report is a series of more than fifty tables presenting the mortality statistics in the various relations discussed in the body of the report. From the studies it appears that spinning-room work heads the list of hazards among the special branches of the industry. Tuberculosis is conspicuous within the industrial age groups as by far the most common single cause of death as well as an important factor in raising the industrial death rate above that of the non-operative population. The high death rate from parturition is probably dependent upon environmental factors conditioned by the existing factory system. — H. W. Stevens.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Adult Tests of the Stanford Revision Applied to College Students. *Helen H. Caldwell.* Jour. Educational Psychology, Dec., 1919, 10, No. 10, 477–488. — The correlation of the test results with scholastic standing is such that the adult tests may be useful to advisory officers in diagnosing cases of unsatisfactory scholarship. — G. E. Partridge.

The Will-Profile. *June E. Downey.* University of Wyoming Bulletin, 15, No. 6a, pp. 37. — A tentative scale is offered for measuring the amount and character of volitional power possessed by an individual. The tests used are tests of handwriting, and provide data about speed of decision, co-ordination of impulses, freedom from inertia, speed of movement, tenacity, flexibility or adaptability, accuracy. No correlation was found between will-pattern and intelligence. — G. E. Partridge.

Intelligence Tests of Yale Freshmen. *J. E. Anderson.* School and Society, April 3, 1920, 11, No. 275, 417–420. — Of the college freshmen, 99.2 per cent. of the men received A and B grades, while 83 per cent. of the officers and only 20.4 per cent. of enlisted men received these grades. The A and B ratings were considered by the army as indicative of the officer type, providing leadership and other necessary qualities were present. The scores of the Yale men are compared with those of college students in other institutions who have been subjected to the same tests. Correlations have been worked out, showing that while there is a positive correlation between standing in the army tests and standing as measured by the records of a half year in college, the correlation is not high enough to be regarded as reliable in application to any individual for the purpose of predicting the future. The article contains data of interest to the practical psychologist in general. — G. E. Partridge.

The Army Tests and Oberlin College Freshmen. School and Society, March 27, 1920, 11, No. 274, 389–390. — The tests were given exactly as they were administered in the army. The median score for men was 153, and the median score for women, 145, the difference being explained as due to the prominence, in the test materials, of experiences more common among men than among women. — G. E. Partridge.

Significance of the Army Intelligence Tests. *R. Dodge.* Education, March, 1920, 40, No. 7, 417–428. — The army tests were valuable aids in measuring intelligence, but many other factors need to be tested in order to determine capacity for special tasks — morale,

enthusiasm, loyalty, perseverance, etc. For these there are no adequate tests in sight. Nor have we any proper estimates of the proportion of such characteristics needed for various tasks. These limitations make scientific vocational guidance at the present time impossible. It is wholly impossible to establish now any simple formula of routine tests for capacity to learn any task — military, educational or industrial. We can test actual accomplishment — information and the ability to use it — but the correlation of accomplishment with the capacity for further development is not so readily determined. When large groups are to be studied with reference to any capacity and must be quickly tested, any quantitative measure is better than none at all, and of all the methods probably the tests for general intelligence are the most useful, but such tests may be grossly misleading so far as any individual is concerned. — G. E. Partridge.

Observations on the De Sanctis Intelligence Tests. *W. B. Drummond.* Brit. Jour. Psychology, March, 1920, 10, Nos. 2 and 3, 259–277. — The primary object of the De Sanctis tests differs from that of the Binet tests: the Binet tests are intended to measure the amount of intelligence; the De Sanctis tests are planned to measure the degree of mental defect. The tests are described in detail, and results are given of their application to normal children. The conclusion is that the tests cannot differentiate between the feebleminded and the normal. Feebleminded persons with a mental age of nine years may pass all the tests. The tests do, however, afford a rapid means of classifying the mentally defective. The De Sanctis tests may be utilized as substitutes for some of the tests of the Binet scale, but cannot take the place of the Binet scale. — G. E. Partridge.

Psychology and Industry. *C. S. Myers.* Brit. Jour. Psychology, March, 1920, 10, Nos. 2 and 3, 177–182. — In industry, including commerce, there are four main themes to which psychology can profitably be applied: fatigue, movement study, vocational guidance, and management. The psychologist, by a long series of experimental studies, has prepared the way for systematic investigation of industrial fatigue. Movement study has as yet scarcely been touched by the psychologist. The field has been occupied mainly by the "industrial efficiency" expert, whose methods have been largely empirical. The study of vocational guidance is founded on that of individual differences, for the basis of which we are indebted to pure experimental psychology. As an example of the application of psychology to industry there are the reaction time tests of workers in a bicycle-ball factory, by which it was discovered that by proper selection of workers thirty-five individuals could do the work that had previously been done by 120.

It is easy to devise tests of manual dexterity. Psychological tests of foresight are also readily devised, and have been applied successfully in investigations on motor tram-drivers. Tests of sensory acuity and discrimination, of artistic endowment, fatiguability, accuracy, neatness, distractibility, improvability, memory for names and faces, powers of observation, accuracy and speed of reasoning, and general information are also available. The objection that such tests do not throw light on moral qualities, etc., is not sound. Moral qualities are tested and the tests are easily supplemented by individual examination and cross-questioning.

Under the application of psychology to management must be included consideration of the causes of industrial discontent and restricted output, of the advantages of different methods of payment and supervision, and of other conditions that affect the efficiency and happiness of the workers. There is much also in the newer psychology of emotions awaiting direct application to industrial problems.

The British Psychological Society is now to consist of three special sections, devoted respectively to education, industry and medicine, and a general section devoted to other aspects of psychology. — G. E. Partridge.

Correlation of Physical Health and Mental Efficiency. *R. L. Sandwick.* Jour. Educational Research, March, 1920, 1, No. 3, 199–203. — Mental power as determined by an intelligence test was compared with the condition in regard to physical defects of 423 students attending a high school. It was found that the defects among the most intelligent group were fewer in number and less serious in character than those among the group that was inferior intellectually. "Although the number of cases is small the investigation adds something to the accumulating evidence that the child of good intellectual ability is also of good physical ability." — G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

The Findings of Official Health Insurance Commissions. *John A. Lapp.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 27–40. — "Compulsory health insurance in 1920," asserts the writer, "is in about the same relation as workmen's compensation for industrial accidents was with regard to legislative adoption, in 1910." On January 1, 1920, commissions in eleven states had considered workmen's health insurance. Four of these commissions — those in California, Ohio, Pennsylvania, and Illinois — carried on thoroughgoing studies of problems involved in health insurance. The California commission as a result of its careful work concluded in substance that: "Social insurance represents an effective means of counteracting some of the harmful effects of sickness under existing conditions; social insurance is almost world-wide in its application; . . . the prevention of sickness goes hand in hand with such insurance."

Prior to 1919 there was a marked tendency to report favorably on health insurance. By that year, however, the writer points out, certain commercial insurance interests were beginning to carry on a more or less active propaganda against the health insurance idea. Commissions seem to have become less optimistic in recommending health insurance. The Wisconsin commission recommended preventive measures rather than a scheme of indemnification.

Among the standards laid down by the California commission which reported unanimously in favor of health insurance are the following:

1. Insurance must be both voluntary and compulsory but as to at least a very large part of the insured, it must be compulsory.
2. The sole carrier of the medical benefit should be the state, but the cash or wages benefit should be carried either by the state, or by a fraternal union, at the option of the insured, but not by private commercial companies operated for profit.
3. Medical benefit should include the worker and his dependent family.

The Ohio commission reported in favor of compulsory health insurance. It recommended the distribution of the cost between the employer and the employee. Benefits to the worker should include: (1) cash payment of part of wages, (2) medical care as required, (3) provision for rehabilitation, (4) dental care, (5) medical care of dependents, (6) burial benefit for the worker.

What was probably the most careful investigation was that of the Illinois commission. In one of its studies it collected data from 3,048 families living in Chicago. In summing up its complete findings the commission called attention to facts such as the following:

1. That approximately two-thirds of the wage-earning families will have one or more cases of serious sickness or non-industrial accident in the course of a year.
2. That something more than a quarter of the wage-earners will be sick or sustain non-industrial accident in the course of the year.
3. That loss of time to wage-earners will average between 8 and 9 days per year for each wage-earner in the entire group.
4. That the average loss in wages and medical bills connected with sickness and accident will approach $75 per year per family when spread over the entire group.
5. That sickness and non-industrial accident are found as a cause or as an accompanying condition of dependency in from a third to half of the cases of dependency not giving rise to institutional care.

Among the findings of the Pennsylvania commission is the one that "industry is clearly responsible for a large proportion of illness among employees. . . . Full one-half of the existing sickness could be eliminated if proper preventive measures were taken."

In conclusion the writer expresses the conviction that existing reports of health insurance commissions are sufficient evidence in favor of adopting compulsory health insurance. — C. H. Paull.

State Accident Insurance in America a Demonstrated Success. *Miles M. Dawson.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 8–14. — As a result of investigations of workmen's compensation in Ohio, Pennsylvania, and New York the writer comes to the conclusion that state funds, particularly the exclusive fund, are superior to insurance provided by commercial carriers. In the states under consideration three types of insurance were involved: (1) exclusive state funds; (2) competitive state funds; (3) private profit-making companies. Attention is called to the low expense of management required for carrying on state compensation insurance. In commercial stock insurance companies the ratio of management expense to premiums often runs as high as 35 to 40 per cent. When this figure

is compared with the ratio for the state fund in Oregon of $7\frac{1}{2}$ per cent., the saving in this particular element is obvious. In Ohio, where the state fund is exclusive, an even lower ratio than this was found by the writer. The following table points out the ratio of management expense to premiums in the three states under consideration:

	Ratio of management expense to premiums Per Cent.
Commercial Stock Insurance Companies	35–49
Pennsylvania state fund (competitive)	9
New York state fund (competitive)	6.2
Ohio state fund (exclusive)	1.625

This saving in management cost obviously reacts upon the premium rates. The New York state fund, for instance, reduces the premiums of policy holders 29 per cent. below what they would have to pay to commercial insurance companies. In Pennsylvania the saving is from 19 to $23\frac{1}{2}$ per cent., and in Ohio where the cost of administration is taken from the state treasury instead of from premiums the saving is at least 35 per cent. The insurance funds of the three states under consideration all have sufficient surpluses to provide for contingencies.

Among the possible defects to be found in a state compensation fund is the danger that economy will be carried to such an extreme as to hamper the development of adequate machinery for the administering of the fund. In Ohio, for instance, there seem to be delays in making awards. In New York State there seems to be the danger that adequate accounting and following up of cases are sometimes neglected.

The writer, however, comes to the general conclusion that although minor abuses may rise out of the present administration of state funds they are, in all essential elements, superior to commercial insurance. In discussing the question of the opposition of certain employers towards state insurance, it is pointed out that in some cases there is a suspicion of any activity carried on under public control. There also seems to be a certain antagonism on the part of some manufacturers opposed to legislation leading to the improvement of industrial conditions. — C. H. Paull.

Disabilities as Aggravated by Pre-existing Conditions. *John W. Mowell.* Mod. Med., Dec., 1919, 1, No. 8, 683–687. — Congenital defects, hernia, partial blindness or deafness, chronic joints, foot troubles, syphilis, goiter, and feeblemindedness are all involved in accident cases and create difficulties in coming to a decision of fair compensation. They often influence the treatment and prognosis of injury and illness in industrial plants. The writer concludes that only by having as complete data as possible in the insurance office concerning each worker can the problem be entirely solved. — A. B. Emmons.

Compulsory Sickness Insurance. Nat. Civic Federation Rev., April 1, 1920, 5, No. 2, 6–8. — This report of the Social Insurance Session of the Annual Meeting of the National Civic Federation contains condemnation of the British Act from various points of view. The main objection on the part of organized labor is that the benefits are inadequate. The objections are also expressed that sickness is too indefinite a term, and that too many people would become addicted to the habit of "being on the funds." Other arguments are offered against the measure from the employer's point of view. Some favorable opinions are expressed. — G. E. Partridge.

The Securing of Proper Medical Service for Injured Persons. *John W. Trask.* Mod. Med., Dec., 1919, 1, No. 8, 675–678. — "The question of satisfactory medical care for injury cases seems to resolve itself into ascertaining who are competent, well-trained surgeons, with the necessary temperamental qualifications, and where they are located, and then placing the injury cases under their care. The experience of the United States Employees' Compensation Commission has been that the whole problem depends upon the selection of properly qualified surgeons who will conscientiously do whatever is possible toward the physical restoration of their patient. This secures the maximum benefit to the injured at a minimum of cost to the government." — A. B. Emmons.

Compensation for Industrial Diseases. Labour Gaz., March, 1920, 20, No. 3, 304–310. — A discussion of the workmen's compensation acts of Great Britain, Canada, United States, and France, with special reference to the relations between accident and disease which the judicial courts and labor commissions have written into the law as a result of their interpretation of these acts. — L. A. Shaw.

REHABILITATION OF DISABLED EMPLOYEES

Rogers Amendment of the Vocational Rehabilitation Act. Educational Record, Jan., 1920, 1, No. 1, 25. — This bill (H. R. 10875) provides for the vocational rehabilitation of any who have suffered a 10 per cent. loss of earning capacity through disability incurred in military service or traceable to military service. — G. E. Partridge.

The Function of Psychology in the Rehabilitation of Disabled Soldiers. *B. T. Baldwin.* Psychological Bull., Aug., 1919, 16, No. 8, 267–290. — There is a need of broad study of individual cases, including investigation of social, educational, and vocational experience, examination to determine skill of various kinds, tests for mental abnormalities, measurement of voluntary movement and muscular strength. From a curative standpoint, there is a wide range and a promising field for the application of psychological data. This study of the individual must be supplemented by an analysis of the movements of occupations considered with reference to their therapeutic uses. Attention must be given also to the development of a normal mental attitude on the part of disabled men. A sketch of some of the work done with the disabled is given. — G. E. Partridge.

Vocations for Maimed Fighters. *St. Nihal Singh.* The Southern Workman, March, 1920, 49, No. 3, 113–120. — The article describes the work done at Roehampton, England, where in some cases men who had been total failures before the war, because of having failed to find suitable occupation, have improved their situation even though disabled. At this institute disabled men have applied for facilities for training in eighty-seven occupations. A list is given of occupations that have been found suitable for men who have lost one leg — occupations such as automobile driving, boot-repairing, metal turning and fitting, commercial work, work as automobile mechanics, electric work, razor-making, light leather work, photography, tailoring, toy-making, etc. The prospects of a man who has lost both legs depend largely upon the point at which the legs have been amputated. Many men who have lost both legs below the knee are holding their own in the industrial world. For men who have suffered amputation of both legs above the knee such occupations as light leather work, basket-work, boot-repairing, tailoring and fancy work have been selected. The positions in the industrial field that can be filled by men having but one arm are limited, but work has readily been found for them as clerks, labor-masters, porters, timekeepers, commercial travelers, watchmen, etc. The man who has lost one arm has more chance if he returns to his old trade or profession — if he has a suitable artificial appliance. In general the man with one arm can work up to about 70 per cent. efficiency in such a trade as wood-working. Over sixty occupations are regarded as available for men who have lost an arm. Even the case of the man who has lost both arms is not hopeless, especially if he has the use of one arm below the elbow joint. — G. E. Partridge.

Reconstruction of American Deafened Soldiers. *A. C. Manning.* Am. Annals of the Deaf, Jan., 1920, 65, No. 1, 74–85. — This is an interesting account of educational work done for the comparatively few men returned from military service with defects of hearing. The effectiveness of system in dealing with difficult problems of reconstruction and re-education is well shown. The article especially emphasizes possibilities in education in speech-reading. — G. E. Partridge.

Rehabilitation in Its Relation to the Physician. *A. C. Burnham.* Mod. Med., Feb., 1920, 2, No. 2, 93–95. — This brief article gives a description of the machinery devised for the purpose of taking care of those members of the U. S. forces who require rehabilitation. — L. Greenburg.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

Volume II — SEPTEMBER, 1920 — Number 5

CONTENTS

GENERAL

Human Engineering — A New Medical Specialty. *Frank Leslie Rector.* Mod. Med., Feb., 1920, 2, No. 2, 133–136. — The author suggests that the term "industrial medicine" be replaced by "human engineering," a name which, in his opinion, defines more clearly the scope and possibilities of what the work offers. The field of activity of the human engineer borders on the following four industrial departments: employment, safety, medical, and welfare, in the making of physical examinations, the follow-up of accidents, the treatment of injured, and the supervision of the home life of the worker. — L. Greenburg.

Industrial Medicine in America and Here. Editorial. Lancet, Dec. 27, 1919, 197, No. 5026, 1199–1200. — This editorial reviews the discussion of the position of the physician and surgeon in the industrial era, which was held in the Clinical Congress of the American College of Surgeons. Application to England is here made of what Dr. Geier pointed out to be true of America, namely, that the medical profession must awake from its social torpor, since labor in seeking compensation for loss of time and wages is ahead of the profession of medicine, with the result that workmen's compensation laws are all promoted without seeking the guidance of those best fitted to inspire and direct such undertakings. The profession must acquire a greater appreciation of the loss to workers in time and wages and to the community in their productivity. The editor agrees with Dr. Geier that henceforth the medical profession "must be familiar with all the factors which affect the health of the employee from sanitation of the factory to the workingman's home, his food and his habits, with occupational diseases, with the factors of fatigue, and long working hours."

Dr. Moorhead considered the problem largely one of education and of preparing the medical student of the future on better lines. Although organizations for industrial health and welfare work have been developed in England, they

have little or no help from the medical profession. The question arises, therefore, as to whether the great field of industrial preventive medicine is to be left to lay organization entirely. Medicine and the public must work in unison if the national health is to be preserved and improved; otherwise much will be done incorrectly, which it will be difficult to undo. — J. C. Aub.

Industrial Hygiene. *J. W. S. McCullough.* Pub. Health Jour., June, 1920, 11, No. 6, 245–256. — This is a reprint of a paper read at the Annual Meeting of the Ontario Safety League at Toronto in April, 1920. The following aspects of industrial hygiene are very briefly touched upon: employment of minors and women; factory inspection; preventable accidents; poisoning from lead, phosphorus, arsenic, mercury, carbon monoxide; dusty trades; textile work; wood dust; coal mining; effects of heat; infections; tuberculosis; physical examination; and the need of a division of industrial hygiene as part of the public health department of every country. — R. M. Hutton.

Uses of Motion Pictures in Industrial Medicine. *Leslie W. Sprague.* Mod. Med., Sept., 1919, 1, No. 5, 396–398. — A statement of the character and utility of certain motion pictures in campaigns for industrial health. — C. K. Drinker.

Value of Plant Records in the Development of Plant Hygiene. *A. R. Hackett.* Am. Jour. Pub. Health, June, 1920, 10, No. 6, 525–527. — In a large number of the states the so-called occupational diseases are being put on the same basis as industrial accidents. A large number of conditions and diseases may be traced to poor plant hygiene while an even larger number can be traced to personal hygiene. In order to show that plant hygiene is or is not responsible for these conditions it is absolutely necessary that accurate records be kept and sufficient clinical and laboratory findings tabulated to show beyond a doubt what is the correct diagnosis.

All hygienic supervision of the plant should originate in the medical director's office and the value of it all depends on the records he keeps and the thoroughness with which they are worked out. In too many instances the medical director is called upon to do so much detail work that records are too brief and many important vital facts are overlooked.

The author states the necessity of a competent medical staff with plenty of full-time clerical help and a thoroughly modern laboratory and X-ray equipment with trained technicians in charge. This is an expensive proposition beyond the reach of the average small plant, but can be adequately met by the combining of several institutions in a given community to support a thoroughly equipped diagnostic clinic. — H. F. Smyth.

Self-Imposed Inspection of the National Canners' Association. *H. M. Loomis.* Am. Jour. Pub. Health, June, 1920, 10, No. 6, 521–525. — This article gives an outline of the inspection service instituted by the National Canners' Association which includes supervision of the raw materials, processes and products, of the factories and utensils and of the habits and dress of the employees. There are in all about thirty general sanitary requirements. It is estimated that at least one-third of the 1919 output of canned goods in the United States was subject to this inspection. Certificates are issued where standard conditions are met with. Many canners have admitted that the spirit of competition or emulation stimulated among their employees by this inspection has been of great benefit to them. — H. F. Smyth.

Air Medical Service. Air Service Information Circular, March 15, 1920, 1, No. 3, pp. 115. — This is a collection of articles which have been printed and of preliminary reports upon work now in progress by the Medical Division of the Air Service. In all cases the problems concern selection of the best physical and mental types for aviation, and their treatment is invariably highly technical in nature and of such limited use outside of aviation problems as to fail to necessitate detailed review. — C. K. Drinker.

The Training of Industrial Physicians. *J. A. Watkins.* Jour. Am. Med. Assn., June 12, 1920, 74, No. 24, 1643–1645. — "Thirty-one medical colleges or universities offer training facilities or instruction in industrial medicine or related subjects. Of these there are two schools offering courses in this subject, leading to certification on satisfactory completion; ten schools offer a limited amount of work in the curriculums leading to the degree of Doctor of Medicine; four universities offer some instruc-

tion in vocational hygiene during the course leading to one of four degrees in public health, the requirements of which are not standardized, while fifteen schools offering postgraduate public health instruction include limited instruction in industrial medicine or related subjects."

Following this statement of the meagre facilities now available for the training of industrial physicians, Watkins gives a very general sketch of the preparation they should obtain. He concludes that the industrial physician should have: "a sound medical education; ample practical experience in medical relief; a well-rounded knowledge of preventive medicine; a thorough knowledge of vocational hygiene; an understanding of our present day social problems, and be able in the light of this knowledge to apply intensively to groups and in a practical manner the best that the medical profession has to offer to society." — C. K. Drinker.

The Function of Part-Time Continuation Schools. *T. W. Gosling.* School and Society, May 15, 1920, 11, No. 281, 571–575. — This type of school is a concession to unfortunate social conditions which make early employment necessary, or to the restlessness of certain kinds of children who find the routine of the full-time school repugnant to their tastes. The continuation school for children under eighteen should be regarded as a merely temporary expedient. The fault lies partly with the child, partly with the school, but the industrial organization has been far too eager to absorb the cheap labor made possible by our undemocratic educational practices. There can be no equality of opportunity, when thousands of our boys and girls are either induced or permitted to enter industry before they are old enough to realize the handicaps they are imposing upon themselves by the curtailment of their educational opportunities. If there is heavy, hard and dirty work to do, work which men avoid if they can, true democracy will not seek merely to assure itself of a continuous supply of the labor by which this work may be performed, but rather will it endeavor, through the application of educated brains, to find means whereby the necessity for this kind of labor may be avoided. The best agencies which democracy has as yet devised are its full-time public schools. The continuation school helps to perpetuate class distinctions; it will best serve democracy by fitting its students for the two vocations, the only two which are well-nigh universal — the vocation of citizenship and the vocation of home-making. Universal and compulsory high-school education should be the goal for all except defectives. — G. E. Partridge.

Shop Industrial Training. Nat. Civic Federation Rev., May 10, 1920, 5, No. 3, 3–4. — This is a report of the discussion held at the annual meeting of the National Civic Federation in regard to the relation of the reduction of the high cost of living to maximum production. Contentment in employment, it is believed, would help to supply the world's necessaries. — G. E. Partridge.

Industries Taught in American Schools for the Deaf. Am. Annals of the Deaf, Jan., 1920, 65, No. 1, 1–22. — A useful list of various industries taught to the deaf, and a tabular statement of schools for the deaf, methods of instruction, industries taught, and other data. — G. E. Partridge.

University Professional Training Courses in Physical Education. *C. W. Hetherington.* Am. Physical Education Rev., May, 1920, 25, No. 5, 185–197. — There is in the United States a vast amount of physical unfitness in the most vigorous years, 90 per cent. of which is due to lack of physical education. But the situation is improving. California and twelve other states have recently passed laws requiring physical education in the public schools, and there is a bill in Congress aiming to do for physical education what the Smith–Hughes bill has done for agricultural education. At the present time there is an enormously increased demand for physical educators, and to meet this need the universities must provide the proper training. The writer attempts to outline in detail the proper function of the university and of the physical educator. The article contains a list and description of the play fields, courts and apparatus needed to carry out the California state program of physical education. — G. E. Partridge.

Problems of Physical Education. II. *D. Snedden.* School and Society, May 15, 1920, 11, No. 281, 575–582. — The conditions of our modern life are highly unnatural, therefore physical training must be special. It must intelligently seek to give preparation, not for life in general, or life as it might have been for

rural or manual working peoples, but for modern needs. We should foresee the conditions and strains which are likely to be encountered, and prepare for them. At present, there is too much of the competitive spirit of a wrong kind in physical training. The adolescent tries, instinctively, to reproduce in himself the ancestral activities; he would fit himself for war, as it were, although, in the great number of cases, he will lead a sedentary life. We tend now, unfortunately, toward a kind of aristocracy in play; the highly cultivated and technically conducted games attract the few. Physical training is extravagant. On the contrary, play ought to be simplified. Leaders in physical education ought to get together to study the minimum essentials of physical development and training, as these might be provided for thousands of boys from ten to eighteen years old. It is surely time for physical educators to study the "simple life." We have too many gymnasiums, relatively speaking, and too little natural and outdoor life. — G. E. Partridge.

Problems of Physical Education. III. *D. Snedden.* School and Society, May 22, 1920, 11, No. 282, 601–606. — Are there essential factors in the physical life that can be produced only by work as contrasted with play? Play and work are very different, certainly in moral effect, and probably in physical. It is probable that substantial amounts of physical work, no less than of physical play, are essential to sound development. "To the writer it seems very probable that a wiser generation, some decades hence, will look back with amazement on such institutions as our summer camps, where adolescent youth, with almost superabundant energy is permitted and expected to spend sixty or ninety summer days in endless varieties of play at a time when what they need most (probably) for the final shaping of body and character is a daily measure of the physical toil which enlarges and hardens many large muscles and promotes the steady, measured action, against persistent resistance, of heart and lungs and stomach, and thus lays best foundations for prolonged bodily well-being." . . . The important work at present is to discover the facts. — G. E. Partridge.

The Position of the Medical Profession in Relation to National Physical Education. *K. Digby Bell.* Lancet, Jan. 31, 1920, 198, No. 5031, 231–235. — In this address, delivered before the Royal Society of Medicine on Jan. 21, 1920, Dr. Bell outlines the scheme of physical education used in training officers under instruction at the R. N. School of Physical and Recreational Training. He discusses at length the three main headings into which physical education is divided according to this system: namely, (a) activity developed by physical training; (b) energy developed by recreational training; (c) character developed by morale training. A chart is included which depicts a system of physical training which, if not ideal, at least treats the subject in its proper sphere of importance and magnitude, and forms a basis for thought and future development.

Dr. Bell gives three great reasons why, in his opinion, Great Britain found herself a C3 race during the critical days of the war: "(1) We have allowed the spirit of competition to concentrate on the training of a few specialists in one or other of our national sports, to the detriment of the mass of less fortunate citizens. . . . (2) The fact that the subject of physical education has not been taken up seriously by the nation, but has been left to private enterprise and so-called experts in various methods. . . . (3) The most important reason for our physical deficiency, in my opinion, is the fact that the subject has not been studied sufficiently by doctors. Our medical schools teach anatomy and physiology more with the ultimate object of curing disease than of preventing it." He concludes by saying, "The country urgently needs a more comprehensive and a better organized system of physical education, and, gentlemen, it is up to our profession to see that it gets it." — M. C. Shorley.

Monthly Record of Current Educational Publications. Department of the Interior, Jan., Feb., April, 1920. — These bulletins contain references to books and articles on vocational guidance, physical education, manual and vocational training, and other topics of interest to the student of hygiene. — G. E. Partridge.

A National Institute of Industrial Psychology and Physiology. U. S. Pub. Health Ser., Pub. Health Rep., May 7, 1920, 35, No. 19 1097–1098. — It has been proposed to establish in London an institution called the National Institute of Psychology and Physiology, which will investigate the human problems of industry and commerce. — L. A. Shaw.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

CIRCULATORY SYSTEM

Recent Statistics of Heart Disease. With Special Reference to Its Increasing Incidence. *Frederick L. Hoffman.* Jour. Am. Med. Assn., May 15, 1920, 74, No. 20, 1364–1371. — This paper presents a general discussion upon the importance of cardiac disease and the difficulty of considering cardiac conditions from a statistical point of view owing to the lack of any large body of knowledge upon the earliest phases of cardiac impairment. A further cause for error in the consideration of mortality data is found in the failure properly to record other causes of death in individuals who have been known to have heart lesions. Hoffman presents the following conclusions:

"I may say that of 8,408 deaths of males, 1,811, or 21.5 per cent., were complicated by diseases of the heart and by specific impairments; 531 cases were complications of valvular disease; 347 cases, of endocarditis; 339 cases, of myocarditis; 215 cases, of organic diseases of the heart not otherwise specified, and 169 cases, of cardiac asthma and dilatation, etc. In the same experience there were 390 deaths from Bright's disease complicated by arterial diseases, principally cerebral apoplexy, from which there were 307 deaths; and arteriosclerosis, from which there were seventy-three deaths.

"The foregoing statement must be sufficient for the present purpose to emphasize the extreme importance of a complete collateral analysis of all the causes of death in any discussion of heart impairments, with particular reference to the question of a possible increase in the observed degree of relative frequency. To those who wish to pursue this question further, it may be suggested that the statistics of the Roosevelt Hospital are of particular value in this connection in that they are available for a period of more than twenty years, and so stated as to emphasize the relative importance of complications, or collateral impairments, as the case may be." — C. K. Drinker.

Heart Disease as a Public Health Problem. *Lewis A. Conner.* Jour. Am. Med. Assn., June 5, 1920, 74, No. 23, 1564–1566. — A plea for recognition of the significance of cardiac disease as a problem in preventive medicine and for the utilization and further development of recognized agencies for the treatment of early cases. — C. K. Drinker.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Anilin Poisoning — Its Diagnosis and Treatment. *R. P. Albaugh.* Mod. Med., Sept., 1919, 1, No. 5, 398–399. — A very brief statement upon anilin. The treatment advocated, after removal of the patient from actual contact with the poison, oxygen artificial respiration, camphorated oil — as a heart stimulant — with care to avoid alcohol for this purpose, would seem singularly inadequate. — C. K. Drinker.

Hygienic Control of the Aniline Dye Industry in Europe. *Charles Baskerville.* Abstracted from Jour. Indust. and Engin. Chem., 1920, 12, 393, by E. J. C. in Chem. Abstr., May 10, 1920, 14, No. 9, 1442. — "An abstract of a report under the above title for the U. S. Dept. of Labor by Dr. Alice Hamilton and a brief discussion of the situation in this country. The need is pointed out for an Institute for Industrial Hygiene in the U. S." — W. O. Fenn.

Bromethyl Poisoning With Fatal Termination. *Edgar Goldschmid* and *Elisabet Kuhn.* Zentralbl. f. Gewerbehyg., Feb., 1920, 8, No. 2, 28–36. — After a brief survey of the cases and symptoms of bromethyl poisoning in the earlier literature, the authors describe in detail nine cases which occurred as a result of the explosion of a kettle of bromethyl and a subsequent defect in the connecting pipe.

In three cases death occurred with practically identical symptoms. After a short feeling of illness, epileptiform, clonic-tonic convulsions appeared, with loss of consciousness and disturbance of respiration which led in a few hours to death.

The other six cases complained unanimously of dizziness, headache, general debility and dis-

turbance of equilibrium. In contrast with earlier findings, there was no case of diplopia or other interference with vision; only one patient, after three weeks, testified to a periodical dimness of sight. Likewise nausea and vomiting, which all earlier writers have recorded, appeared only in one case, after a week. Only one had clonic-tonic convulsions which were limited to four separate attacks starting in the right hand. Two cases showed conditions of psychic excitability — delirium, hallucinations, and somnolence. In all cases there were normal blood findings, no methemoglobin, and frequently biliary pigments in the urine. Investigation of the nervous system gave practically uniform results: absence of conjunctival and pharyngeal reflexes; positive Romberg; otherwise normal findings. The men all appeared stupid, and as if consciousness were maintained with difficulty. In the course of treatment they evinced a depressed, melancholy disposition which continued for a long time. Examination over seven months later showed them all capable of work, but apparently nervous; Romberg still faintly positive; trembling of hands and outstretched tongue; conjunctival and pharyngeal reflexes still faintly positive; but other reflexes normal.

Postmortem examination of the three who died showed excessive changes of the cortex of the brain in all cases; in the one completely sectioned case, acute inflammation of the respiratory tract in the form of purulent bronchitis, and inflammatory edema of the lungs. — M. D. Ring.

Nitrobenzene Poisoning With Cyanosis. Report of Case. *Frank G. Sanders.* Jour. Am. Med. Assn., May 29, 1920, 74, No. 22, 1518–1519. — "On the evening of Feb. 7, 1920, at about 6.30, a well dressed young man was brought into the Johnson and Beall Hospital. He was a railroad employee and had been in excellent health until the present afternoon. He had spent the afternoon at the theater and had gone to the interurban station to take the 6 o'clock car. The last thing he remembered was looking at his watch and noting that it was 3 minutes to 6. The person who brought him in stated that he had driven up to the mail box about 6 o'clock and had found the patient leaning over the package box apparently unconscious. He had brought the man directly to the hospital.

"The patient was of good physique. He was conscious, but seemed confused, and said that he was dizzy and that his chest was full of something. He was markedly cyanosed and gave the appearance of being intoxicated. The skin was cool and moist, the temperature normal. The heart and lungs were negative, as was the abdomen. During the examination a very decided odor of nitrobenzene became apparent, and this odor was traced to his shoes. Further questioning revealed the fact that the patient had had his shoes dyed immediately before going to the theater, and that he had sat in that poorly ventilated place all the afternoon breathing the fumes from his shoes. The shoes were very tight also, and direct absorption might have been a factor. The patient denied having a drink of any kind or any unusual food.

"The man's shoes were removed and he was placed by the open window. Within an hour he was able to go home, with some assistance. He was advised to keep his shoes away from him and to stay by the open window. By the evening of the next day, his cyanosis had disappeared along with the subjective symptoms, and the patient was able to return to his work apparently none the worse for his experience." — C. K. Drinker.

Physiological Action of Nitrobenzene Vapor on Animals. *Wallace L. Chandler.* Abstracted from Cornell Univ. Agr. Expt. Sta., Memoir, 1919, 20, 407–472 by J. S. Hepburn in Chem. Abstr., May 10, 1920, 14, No. 9, 1386. — "Expts. were made on dogs, rabbits, guinea pigs, gray rats, white rats, cats, hens, pigeons and certain parasites. Conclusions: Apart from a possible disturbance of the digestive functions and a possible asphyxia due to direct action on the blood, most of the symptoms of poisoning by nitrobenzene may be explained on the basis of disturbances in the cerebellum or cerebellar paths. Inhalation of the vapor of nitrobenzene in toxic doses produces chromatolytic degeneration of the Purkinje cells of the cerebellum. Histological examns. have shown only this degeneration and morphological changes in the erythrocytes. The blood may contain methemoglobin. The size of the lethal dose depends on certain conditions such as the amt. and kinds of fat in the blood; these conditions govern the concn. of the nitrobenzene in the vicinity of the nerve cells. A latent period elapses between administration of nitrobenzene and the onset of the symptoms of poisoning; during this period the nitrobenzene

is first absorbed from the blood and retained by the liquid fats of the body; then as its concn. in the blood lipins decreases with respect to its concn. in the body fats, it again passes into the blood; finally its concn. in the lipins of the cerebellar or other brain cells becomes sufficiently great to produce the onset of motor symptoms. The duration of the latent period depends in part on the same factors as control the size of the lethal dose, and in part on the condition of the brain lipoids. Nitrobenzene cannot be used with any degree of safety for fumigation of animals to destroy their external parasites; it should not be used as a flavor, as a perfume, or as a solvent in such prepns. as shoe polish or floor wax, and should receive serious consideration as an industrial poison in dye works, etc. A bibliography of 27 references is given." — W. O. Fenn.

Dinitrobenzol and the Optic Nerve. *R. Cords.* Zentralbl. f. Gewerbehyg., Jan., 1919, 7, No. 1, 6–11. — The general symptoms of poisoning with aromatic nitro-compounds, especially dinitrobenzol, have been known since 1901. The author's experience has been with a great number of cases showing disturbance of the optic nerve as a result of exposure to the poison in the munitions factories of the Rheinland. He classes these in four groups ranging from light, temporary disturbances to the most severe progressive disorders. In the first group the cases coming under observation are rare because usually the symptoms are too transitory to be reported. In those cited there was in general a slight lowering of visual acuity, from one-half to one-third with no central prolapse of visual field for color points. Occasionally there was a slight veiling of the papillary boundaries and a somewhat increased filling of the veins. In the second group the author placed cases of greater veiling of papillary boundaries with hyperemic discoloration and a striking dilation of the veins, together with a considerable lowering of central vision from one-tenth to one-fiftieth, and a relative central scotoma for red and green. The cases in the third group were most numerous. Here were found more or less pronounced processes of papillitis which later produced a temporal paling of the spot of the optic disk. In all of these there was an advanced central scotoma whereby frequently the red-green vision, and frequently the whole color sense was lost. There was often a difference of pupil, pronounced contraction and a noticeable inactivity toward light and convergence. The fourth group is the rarest. The author cites only one case in which progressive changes took place leaving the papilla entirely white, and a large absolute scotoma with the field of vision greatly narrowed.

In reviewing the factors which apparently increase susceptibility to this poisoning, Cords states that old age, poor nutrition, and excessive use of alcohol or tobacco were all effective. The cause of the phenomenon seems most reasonably explained as chronic disturbance of the nutrition of the optic nerve which is furnished with a blood supply poor in oxygen and highly thickened.

On the ground of these investigations, the author advises that there be strict enforcement of regulations, excluding from industries using nitrated hydrocarbons of the aromatic series those who are especially disposed to visual disorders on account of active earlier poisons (alcohol, tobacco, lead, carbon bisulphide, anilin, lues, and diabetes). Moreover, the admission of women, especially during the menstrual period and pregnancy, is inadvisable.

The results of poisoning are so serious that frequently the capacity for reading newspaper print and writing is lost. Workers themselves are apt to neglect the symptoms, partly because they consider them transitory, and partly because they do not wish to lose the high advantage accruing to them from the hazards of the industry. — M. D. Ring.

The Mercury-Free Dressing Process Devised By Dr. Karl Kurzbremen and the Question of Supplanting Mercury in the Pelt Dressing Industry. *Fr. Bortfeldt.* Zentralbl. f. Gewerbehyg., April, 1919, 7, No. 4, 53–57. — The author gives an account of the early history of making felt hats by hand, together with his theory of the action of the two constituents in dressing mixtures, mercury and nitric acid. Two of these mixtures are in common use, one containing more mercury than the other. The solution containing the smaller amount of mercury acts more quickly and produces a yellower felt, whereas the solution richer in mercury always gives a product more leathery in texture and of greater toughness. The function of the nitric acid is apparently to dissolve the outer rind of the hair, while the mercury serves to protect this from too rapid action.

Doctor Kurz found that tannic acid could be satisfactorily substituted for mercury in this process. Sumach solution and nitric acid were mixed and kept cold and in this condition were brushed upon the fur, which was then placed in the drying room at a temperature of 55° R. The author has used this method personally and has made hats of the fur of both rabbits and hares by the process, with entirely satisfactory results.

Since mercury can be thus dispensed with in the making of felt, the question arises whether or not its use should be forbidden. The author realizes that it is difficult for a manufacturer to change his plant over for the utilization of new raw materials. The quality of the product is likewise somewhat changed. New industries will, however, find in the above substitution financial advantage and possibly greater safety to employees. On the other hand, the process of felt making is difficult enough not to warrant any new procedure which is likely to make it harder. — M. D. Ring.

DUST HAZARDS AND THEIR EFFECTS

Dust Removal in the Transvaal Mines. *Junghans.* Zentralbl. f. Gewerbehygiene, Jan., 1920, 8, No. 1, 14–20. — The author emphasizes the fact that removal of dust and of gases, and provision for sufficient renewal of air both with reference to quantity and to temperature must be considered from a single viewpoint and treated as a whole. Air alone used for ventilation stirs up clouds of dust, whereas water alone used for settling the dust interferes with natural ventilation and reduces the renewal of air a fourth or a third.

Two suggestions are made whereby water and compressed air can be used together; one a process in which water by means of high pressure is flung against a solid wall and thus divided into fine streams, and the other, the direct spraying of water by compressed air. The latter is to be preferred since in this way the size of the water particles can be controlled and the stream direction regulated. The size of water particles is of greatest significance in the removal of dust and gases: large drops have little value, falling quickly without action; on the other hand, the water can be too finely divided, producing a mist which only darkens the air indefinitely. The author reports results of experiments carried out in an effort to estimate the most advantageous division of the water stream. The spray was so arranged that by means of an adjustable diaphragm the quantity of water and air could be regulated. Air pressure of about 30 kg. was used, and the air consumption accordingly amounted to about 2300 l. per minute. The nozzle openings were 3.2 mm., 0.8 mm., and 0.4 mm. in the different experiments. With the 3.2 mm. opening 95.26 per cent. of the fine dust was removed. The water vapor present in the air at a distance of 10 m. was 2.96 gm. per cubic meter. A drizzling rain could be felt at a distance of 30 m. With a 0.8 mm. nozzle, 77.5 per cent. of the fine dust was removed. The water vapor at a distance of 10 m. amounted to 4.38 gm. per cubic meter of air. The water particles were so small that they appeared like a mist. With an opening of 0.4 mm. a thick mist was produced even at a distance of 30 m. The air was saturated with water vapor, containing 4.76 gm. per cubic meter at a distance of 10 m. The mist persisted forty minutes after the spraying apparatus was shut off. In this case 54.0 per cent. of the fine dust was removed. Thus, 3.2 mm. is the best size of opening for the water spray for removing dust.

Since carbon monoxide is only slightly soluble in water, it is not removed by this method, so intensive ventilation is necessary in addition to the spray. This direct ventilation is best obtained by a combination of systems: i. e., blowing in fresh air under pressure and at the same time removing the used air with suction pipes.

The author states the necessity of direct sprinkling of large piles of rocks and the need of making especial provisions before blasting.

By the use of these methods the Transvaal mines, formerly hazardous because of their dust, have reduced the death rate from tuberculosis a fifth. There are now no gold mines in this region which are unprovided with the necessary equipment of these water sprays. — M. D. Ring.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Anthrax: Comparison of Surgical and Nonsurgical Methods of Treatment: A Review of Fifty-One Cases Treated at the Massachusetts General Hospital From 1888 to 1918. *Albert J. Scholl.* Jour. Am. Med. Assn., May 22, 1920, 74, No. 21, 1441–1444. — "The majority of the methods of treating anthrax described in the literature are conservative. Surgical intervention offers very little. The organism is building up protective barriers and walling off and splinting the infected area. The main contention of those advising surgery is that the lesion is strictly a local one, and excision should be performed before generalization takes place. On the contrary, there is probably a systemic infection from the onset, but in most cases it is not so great that the organism cannot overcome it. The involvement of neighboring lymph glands which is seen in most cases, and the marked edema which, at times, extends as much as 25 cm. beyond the local lesion, argue against a localization of the infection. A wide excision through this edematous area, giving an extensive field for absorption, opening up many new portals of entry is sufficient, in some cases, to overcome completely the resistance of the patient."

The author concludes with the following summary:

"1. The early diagnosis is made bacteriologically by the demonstration of the anthrax bacilli in the wound. Anthrax bacilli were found in 81.2 per cent. of the cases treated at the Massachusetts General Hospital.

"2. The general symptoms give no constant indication of the severity of the infection.

"3. The mortality in the cases reviewed was 13.7 per cent.

"4. Four of nine patients (44 per cent.) treated surgically died; only three (7 per cent.) treated nonsurgically died.

"5. Forty-two patients had lesions on the face and neck. Cervical infections are especially dangerous; two of the patients treated nonsurgically died from respiratory difficulty resulting from the associated edema.

"6. The patients treated nonsurgically were confined to bed. Their lesions were left absolutely alone and exposed to the air; no special general measures were carried out.

"7. In several of the surgical cases a rapid increase in the edema, a steady decline in the patient's general condition, and death several hours later definitely pointed to the operation as the causative factor." — C. K. Drinker.

British Provision for Tuberculous Ex-Soldiers. U. S. Pub. Health Ser., Pub. Health Rep., April 30, 1920, 35, No. 18, 1043–1045. — A deputation representing the Interdepartmental Committee on Tuberculosis, the Papworth Tuberculosis Colony, and the Norfolk Branch of the British Red Cross Society, in a memorandum to the British Minister of Health, revealed the fact that tuberculous patients who return from a sanitorium to their homes and former occupations are unable permanently to earn a living or maintain their health. The same deputation makes recommendations for the adoption of a village settlement, a brief description of which will be found in this article. — L. A. Shaw.

The Municipal Workshop: A Scheme for the Post-Sanatorium Employment of the Consumptive Ex-Soldier. *F. Stanley Tinker.* Lancet, Feb. 21, 1920, 198, No. 5034, 457–458. — It is universally admitted that the length of sanatorium treatment for the working-class population is unduly short and can only be expected to arrest the disease in a small percentage of very early cases. It is practically impossible, however, to induce the average town-dweller to stay for a more prolonged period, first, because he cannot understand the necessity of continuing treatment after he feels well, and second, because the needs of his dependents force him to return to care for them. The problem, therefore, has become one of improving methods of after-care, a scheme for which is contained in this article. It is suggested that work of a suitable kind be provided in special municipal workshops within easy access of the patients' homes, and under medical supervision. The workshops should be divided into two parts; one to provide training in suitable occupations, and the other a permanent workshop in which the training could be put into actual use. In both parts, the conditions and hours of work would be regulated by the medical officer in charge, who would see the men at stated intervals and assess the number of hours work a day. The work should consist of light manual employment in selected

trades, the correct selection of which is extremely difficult and of infinite importance, as upon it rests the success or failure of the scheme. A good mid-day meal should be provided so that no energy is lost by the men in going home. The shops would be open for eight hours a day, and five and a half days a week, but it would depend on the physical fitness of the worker how many hours he would be able to work.

The objects claimed for this scheme are as follows:

"1. Economy in the long run. Less initial outlay. Less frequency, and eventually almost total abolition of relapse, and the production of useful work by an otherwise idle population.

"2. Immediate relief. Some such scheme could be put into working order while the plans of colonies are still being prepared.

"3. An outlet for the men when their time of training under the Ministry scheme is complete instead of their being faced with the open market of competitive labour in the old unsuitable workshop.

"4. It will work in and not against any existing or proposed schemes. . . ." — M. C. Shorley.

International Standards of Public Health and Welfare Work. *William C. White.* Lancet, Oct. 25, 1919, 197, No. 5017, 719–720. — In this address delivered before the British National Association for the Prevention of Consumption, in London, October 16, 1919, Dr. White, Medical Director of the Tuberculosis League of Pittsburgh, proposes certain essentials of international standards, his object being to render effective the work of all organizations against tuberculosis — in other words, to fit the equipment to the task to be done. His suggestions are: first, a careful analysis of each region in order to find out exactly the specific task to be performed; second, the establishment of a building unit of public health nurse and her territory; and third, the correlation of these on the basis of adaptation to the region to be handled. To push these standards throughout the world will require constant modifications based upon a knowledge of language and of the origin and former condition of the people to be cared for. A step toward obtaining such knowledge has already been taken in the establishment of a number of international scholarships in public health nursing. — J. C. Aub.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Safety Measures in the Production of Explosives. *R. Fischer.* Zentralbl. f. Gewerbehyg., March, 1919, 7, No. 3, 37–42. — The author gives forty-five rules with regard to instruction of workmen, regulation of wearing apparel (fire-proof garments, nailless shoes, etc.), inspection of buildings, precautions in heating and lighting, methods of storing and packing explosives, as means to prevent all possible sources of accident. — M. D. Ring.

Accidents and Accident Prevention in Machine Building. Revision of Bulletin 216. *Lucian W. Chaney.* U. S. Bur. Labor Statis., Bull. No. 256, Nov., 1919, pp. 123. — The investigation reported in this bulletin was undertaken not only to ascertain the frequency and severity of aidents in the machine-building industry but also to study and analyze these accidents in such a way as to supply the information necessary for effective safety work. Tables are given showing accident rates for 1912 by character of product, and by departments; course of accident rates over a series of years; frequency and severity of accidents among American and foreign-born workmen; and day and night accident distribution. Chapters follow on *Safety Organization*; *Direct Safeguarding Methods in Machine Building*; and *Machine Design as a Factor of Safety.* — M. C. Shorley.

Accidents at Metallurgical Works in the United States During the Calendar Year 1918. Compiled by *Albert H. Fay.* U. S. Bur. Mines, Tech. Paper 256, Jan., 1920, pp. 23. — The statistical tables in this report show the classification and the number of accidents at metallurgical works in the United States during 1918. — M. C. Shorley.

Metal-Mine Accidents in the United States During the Calendar Year 1918. (With supplemental labor and accident tables for the years 1911 to 1918, inclusive.) Compiled by *Albert H. Fay.* U. S. Bur. Mines, Tech. Paper 252, Jan., 1920, pp. 113. — In this statistical compilation, tables are given showing accidents by causes, states, industrial

groups, and mining methods for each of the five divisions of the mining industry as follows: copper mines; gold, silver, and miscellaneous metal mines; iron mines; lead and zinc mines (Mississippi Valley); and non-metallic mineral mines. — M. C. Shorley.

Accident Prevention in the Automobile Industry. *F. H. Moody.* Pub. Health Jour., June, 1920, 11, No. 6, 259–265. — This is a reprint of a paper read at the Annual Meeting of the Ontario Safety League at Toronto in April, 1920. The writer points out that while the value of safeguards when applied rationally cannot be overestimated, the full effectiveness of safety engineering is sometimes injured by the "super-enthusiast." "The subject must be approached rationally, never losing sight of the present day slogan 'Increased Production.'" After describing the protective devices in use at the works of the McLaughlin Motor Co., Ltd., Oshawa (a subsidiary of the General Motors Co. of Canada, Ltd.), the progress in safety education and the equipment for first aid, an account is given of a plan for central organization for the promotion of safety work throughout the various divisions of the General Motors Corporation. — R. M. Hutton.

INDUSTRIAL SURGERY

War Contributions to Industrial Surgery. *Stanley R. Maxeiner.* Mod. Med., March, 1920, 2, No. 3, 231–235.—The author describes certain lessons learned in war service which he feels may be applicable to industrial surgery.

"Blood transfusions prepared wounded soldiers for extensive surgical operations and saved thousands of lives. Every hospital should have a pathologist or technician available for grouping patients, and donors, already grouped, should always be accessible from among its employees. Blood should be transfused before, during, or after operations on patients suffering from severe shock.

"More attention and better care of the slightly injured are indicated.

"Débridement should be performed on contaminated wounds of industry the same as on war wounds. Primary, delayed primary, or secondary suture should be practised extensively in an attempt to shorten the period of disability in industrial injuries.

"Anti-tetanic serum should be used in all industrial cases with abrasions of the skin.

"Conversion should be made where possible, of compound fractures into simple fractures, following a débridement, the cases usually calling for delayed primary suture. Earlier passive motion and massage of contiguous joints in all fractures is advisable. General adoption of the Thomas outfit for the transportation of patients with fractures of the extremities is urged.

"The radiologist should indicate more careful localization of foreign bodies with indelible marks upon the skin before open operation for their removal.

"Routine closure of wounds of joints after thorough mechanical cleansing should be practised.

"Early incisions are called for in septic joints in conjunction with Dakin irrigations and passive motion.

"Ether and chloroform should be displaced by the safer and better methods of anociassociation or local anesthesia. Cushing advocated local anesthesia for all craniotomies; it is advocated by others for all operations on the chest and it certainly is called for in almost all minor operations.

"The employment of trained attendants for late treatment of cases with functional results below normal is recommended and the establishment of schools for the re-education of the industrial cripple.

"The war has taught many lessons and it would seem that their greatest field for usefulness is in industrial surgery, in which field they apply not only to the specialist but to every general practitioner who is occasionally called upon to treat such cases." — L. Greenburg.

The Treatment of Mutilated Fingers and Especially Thumbs by Autoplastic Operations and Transplantations. *C. Lenormant.* Presse méd., April 17, 1920, No. 23, 223. — Loss of the thumb is, of course, as serious as loss of all four of the other fingers. Hence plastic reconstructions are most often practiced for this digit. The simplest form is mobilization of the metacarpal, by section of the interossei (though carefully preserving the thenar muscles), and suture of the dorsal to the palmar cutaneous flaps. Digits constructed in such a way are better than none, and a child

can learn to write with one, but prehension is the only function which is retained, and the cosmetic result is bad. There are two methods of reconstruction from tissues at a distance which offer some hope of success: autoplastic reconstruction. and transplantation of another digit. In the autoplastic method, the stump of the lost digit is implanted into the skin of the abdomen or thigh, and when vascular connections are well established, a flap is cut from its original situation and formed into a finger. It may be left soft, or a graft of tibia or rib may be placed inside it at a tertiary operation; or the osseous graft may be planted beneath the proposed site of the cutaneous graft as a preliminary. Autoplastic transplants may be made from the toes or remaining fingers; they too are grafted in by the Italian method, and the tendons then sutured in. They are rather likely to sphacelate or to become obstructed by adhesions and bands. Those from the small toes are the least mutilating, but also the least useful. — T. J. Putnam.

A Study of Traumatic Hernia, So-Called, Among Railway Employees. *C. W. Hopkins.* Mod. Med., Sept., 1919, 1, No. 5, 389–393. — "Hernia results from a developmental defect and accidental injury can be only a secondary cause.

"So many unjust claims are allowed under present conditions that the law should take cognizance of the fact, and definitely settle the matter.

"The only protection possible at the present time is the routine examination of all employees for record for their physical condition at time of employment."

In the opinion of the author, hernia is especially frequent among foreigners and these men are particularly apt to force the company to "buy" an old hernia which far antedates their employment. "If rational interpretation in such cases is not made, workmen with this inherent weakness will have to be excluded from certain industries." The ruling of the Nevada Industrial Commission, Sept. 26, 1913, is cited as in accord without modern ideas upon this subject. — C. K. Drinker.

Relation of Orthopedic Surgery to Industrial Surgery. *Roland Hammond.* Jour. Am. Med. Assn., July 24, 1920, 75, No. 4, 213–214. — This paper, read before the Section on Orthopedic Surgery at the American Medical Association meeting, April, 1920, outlines the future position of the orthopedist in relation to industry, and makes a particular plea for surgical supervision of the injured during late convalescence and at the time of returning to work. — C. K. Drinker.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

First Annual Report of the Industrial Fatigue Research Board to 31st March, 1920. London, 1920, pp. 31. — A brief account of the organization and work of the English Industrial Fatigue Research Board, giving the personnel, plans for research and accomplishment of the organization. A list of the publications of this board is as follows:

No. 1. — The Influence of Hours of Work and of Ventilation on Output in Tinplate Manufacture, by H. M. Vernon, M.D. (*Price 6d. net.*)

(The fatigue and output of mill-men working on shifts of different length and in factories with different systems of ventilation are compared, the data being obtained partly from existing records and partly by direct observation.)

No. 2. — The Output of Women Workers in Relation to Hours of Work in Shell-Making, by Ethel E. Osborne, M.Sc. (*Price 6d. net.*)

(Embodies the result of a small investigation based on the booking of hourly output of 43 women engaged in shell-making during one week on two 12-hour shifts and during one week on three 8-hour shifts, and compares the fatigue and output under the two systems.)

No. 3. — A Study of Improved Methods in an Iron Foundry, by C. S. Myers, M.D., ScD., F.R.S. (*Price 2d. net.*)

(Describes the effect on fatigue and output of the methods adopted in a certain iron foundry in the Midlands.)

No. 4. — The Incidence of Industrial Accidents upon Individuals, with Special Reference to Multiple Accidents, by Major Greenwood and Hilda M. Woods. (*Price 6d. net.*)

(A statistical investigation of certain accident records kept by the Ministry of Munitions.)

No. 5. — Efficiency and Fatigue in the Iron and Steel Industry, by H. M. Vernon, M.D. (*In preparation.*)

(Based on an extensive investigation into the iron and steel industry through the country.)

No. 6. — The Speed of Adaptation to Altered Hours of Work, by H. M. Vernon, M.D. (*In preparation.*)

No. 7.—Individual Differences in the Cotton Industry, by S. Wyatt, M.Sc. (*Price 6d. net.*)

Copies of these reports can be purchased from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, England. — C. K. Drinker.

Prevention of Fatigue in Industry —IV. Psychological Tests and the Reduction of Necessary Fatigue. *Reynold A. Spaeth.* Indust. Management, April, 1920, 59, No. 4, 311–313. — Dr. Spaeth calls attention to the probabihty that the industrial misfit is the first to be affected by the pace in an intensive occupation. Although there is no immediate prospect of a scheme by which workers can be assigned to occupations with unerring precision, the use of trade and psychological tests has already proved of value in the army and in connection with certain types of civilian work. Psychological tests at present show the probability of the individual's succeeding in a certain line of work rather than locating him definitely outside of or within a certain field. But even this is a marked improvement on the commonly accepted haphazard methods of selection. "Success and satisfaction are likely to go hand-in-hand in an industrial job. If we can place our workers in jobs for which they are physically, physiologically, and psychologically fitted — the chances of cumulative fatigue will be reduced to a negligible minimum." — C. H. Paull.

Prevention of Fatigue in Industry —V. Certain Limitations of Scientific Management. *Reynold A. Spaeth.* Indust. Management, May, 1920, 59, No. 5, 409–411. — Dr. Spaeth calls attention to the danger of laying too much stress upon the purely mechanical phases of scientific management. While proper tools, adequate instructions, and time studies make valuable contributions to production, they are by no means the only factors involved. Too frequently the rate at which workers are expected to produce is considered quite apart from such elements as lighting, ventilation, and heating. Scientific management is not merely a problem for the engineer. If its achievements are to have permanent value they must also involve the experience of the psychologist, the physiologist, and the psychiatrist. Wherever the human element is involved, there is a task for the human engineer.

At present, time study methods lack standardization. It is suggested that a committee be appointed by the Society of Industrial Engineers, and that this committee include not only time study men but also representatives of the group of human engineers. Only when time studies are standardized upon the basis of the combined experience of the time study man and the physician and his associaties may we look for the elimination of fatigue as a dangerous factor in scientific management. — C. H. Paull.

A Cardiovascular Rating as a Measure of Physical Fatigue and Efficiency. *Edward C. Schneider.* Jour. Am. Med. Assn., May 29, 1920, 74, No. 22, 1507–1510. — This need of a measure for physical efficiency whereby degrees of fatigue, physical fitness and health may be determined has been felt alike by the medical profession and instructors in physical education and school hygiene. Of late, the newly awakened interest in industrial efficiency has shown that we lack satisfactory and reliable tests of fatigue.

The most satisfactory test for fatigue and loss in physical fitness would be one that eliminates the "personal equation" of the examiner and the anxiety and dishonesty of the patient. Replies to questions concerning symptoms and habits are often misleading because of a preformed opinion by the examiner or because the patient is incapable of self-analysis and accurate description of his experiences. Furthermore, for personal reasons some men would prefer to mislead the examiner, and the test should not, therefore, demand much co-operation and attention from the patient.

Any regular physical training should produce certain functional changes in the body. The cardiovascular changes during altered physical fitness have been studied most, and it is these that are considered in this paper. The tests here discussed should not be confused with functional heart tests, since our concern is with cardiovascular changes only so far as they give evidence of fatigue and health changes in the body.

THE PULSE RATE AS A CRITERION OF HEALTH

(*a*) *The Postural Rates.* — Meylan concluded that a horizontal posture pulse rate between 40 and 50 and a vertical posture rate betweeu 50

and 90 were favorable health signs. Dawson found that training slowed the resting pulse rate as much as 9 beats per minute and this especially influenced the noon and afternoon pulse. He also found that acute infection caused an increase in the pulse rate, but this was much less pronounced in the trained than in the untrained man. In young men, the normal average pulse rate has been reported to be 78.9 standing, 70.1 sitting, and 66.6 lying.

(*b*) *Pulse Rate Increase on Standing.* — Vierordt found that on the average the pulse increase is from 12 to 14 beats between reclining and standing. Crampton reported that in vigorous subjects there was little change, while in wearied subjects there may be an increase of 44 beats per minute. It is now recognized that in states of debility the postural difference may be as much as 30 to 50 beats per minute. A slow horizontal and a slow vertical postural rate with a small difference between the two are usually signs of excellent health.

(*c*) *Exercise Pulse Rate.* — The increase in the pulse rate after a certain amount of work is greater in the untrained than in the trained person. Hartwell and Tweedy, comparing athletic and non-athletic women, found that running up and down stairs accelerated the heart rate an average of 10 beats more in the non-athletic women.

(*d*) *The Decline in Pulse Rate After Exertion.* — Flack and Bowdler, from a study of the reactions following stepping on a chair five times in fifteen seconds, conclude that the heart rate in the healthy subject should not increase more than 25 beats and should return to normal within thirty seconds. Meakins and Gunson report that after a climb of twenty-seven steps at a brisk walk, the pulse rate returned to normal within one minute in healthy subjects, while in patients it required as much as five minutes.

It should be emphasized that while the several pulse-rate criteria of fitness may all be found in a single person, not one or even any two of them is found to be an absolute test. In forming a judgment as to the physical condition of a man it is best to consider together the postural rates, the increase on standing and after exercise, and the time required for the rate to return to normal after exercise.

THE ARTERIAL BLOOD PRESSURE AS A CRITERION OF CONDITION

(*a*) *The Normal Arterial Pressures.*— While it has been held that training raises the systolic blood pressure, the best recent opinion is that during rest the blood pressure of the trained and untrained individual is the same.

(*b*) *Postural Changes in Arterial Pressures.* — In normal subjects the systolic pressure is 10 mm. higher in the standing than in the recumbent position. Sewall has shown that individuals in whom there is excessive gravitation of the blood to the limbs and splanchnic area on standing are victims of physical weakness and nervous instability and often suffer from headache, dizziness, or tinnitus in the erect posture. Crampton demonstrated that a subject might, when standing, show weakness by a decrease in the systolic pressure or by a large increase in the heart rate. Recently, Sewall has pointed out that a weakened patient on standing may fail to show the systolic drop, but instead may have an inordinate rise in diastolic pressure. He employs this rise in diastolic pressure and low levels of pulse pressure as measures of fitness.

These observations on pulse rate and blood pressure suggest thoroughly objective methods of measuring fatigue, staleness and weakness. Various efforts have been made to utilize them but all are subject to error. Schneider and his associates in their work with aviators have developed the following system of grading cardiovascular reactions.

POINT SYSTEM FOR GRADING CARDIOVASCULAR REACTIONS

"This scheme uses in part a plan proposed by Dr. J. H. McCurdy for rating infantry men in cardiovascular and neuromuscular efficiency. The scores for each of the six items range from +3 to −3. A perfect score, the sum of the value given to each of the six items, is 18. The values as assigned appear in Table 1, Parts A, B, C, D, E and F. In using the table for scoring, Parts A and B, also C and D, must always be used together. Thus, if an individual has a pulse rate increase of 15 beats (see Part B) on standing and his reclining rate was 60 (see Part A), he is graded 3 on his standing increase. However, if his reclining rate had been 100, then a standing increase of 15 would have been scored 0."

PROCEDURE IN MAKING OBSERVATIONS

"1. The patient reclines for five minutes. (*a*) The heart rate is then counted for twenty seconds. When two consecutive twenty second counts are the same, this is multiplied by 3 and recorded. The score is noted according to Part

A, Table 1. (*b*) The systolic blood pressure is next taken by auscultation; two or three readings are made as a check.

"2. (*a*) The patient stands at ease for one or two minutes to allow the pulse to assume a uniform rate. When two consecutive twenty second counts are the same, this is multiplied by 3 and recorded. The score is obtained by use of Part C, Table 1. The difference between the standing and reclining pulse rates is scored then by use of Part B, Table 1. (*b*) The standing systolic pressure is next taken. The difference between this and the reclining systolic pressure is then scored by Part F, Table 1.

TABLE 1.—POINTS FOR GRADING CARDIOVASCULAR CHANGES

A. Reclining Pulse Rate		B. Pulse Rate Increase on Standing				
Rate	Points	0–10 Beats, Points	11–18 Beats, Points	19–26 Beats, Points	27–34 Beats, Points	35–42 Beats, Points
50–60	3	3	3	2	1	0
61–70	3	3	2	1	0	−1
71–80	2	3	2	0	−1	−2
81–90	1	2	1	−1	−2	−3
91–100	0	1	0	−2	−3	−3
101–110	−1	0	−1	−3	−3	−3

C. Standing Pulse Rate		D. Pulse Rate Increase Immediately after Exercise				
Rate	Points	0–10 Beats, Points	11–20 Beats, Points	21–30, Beats, Points	31–40 Beats, Points	41–50 Beats. Points
60–70	3	3	3	2	1	0
71–80	3	3	2	1	0	0
81–90	2	3	2	1	0	−1
91–100	1	2	1	0	−1	−2
101–110	1	1	0	−1	−2	−3
111–120	0	1	−1	−2	−3	−3
121–130	0	0	−2	−3	−3	−3
131–140	−1	0	−3	−3	−3	−3

E. Return of Pulse Rate to Standing Normal after Exercise		F. Systolic Pressure, Standing Compared with Reclining	
Seconds	Points	Change in Mm.	Points
0–60	3	Rise of 8 or more	3
61–90	2	Rise of 2–7	2
91–120	1	No rise	1
After 120:		Fall of 2–5	0
2–10 beats above normal	0	Fall of 6 or more	−1
11–30 beats above normal	−1		

"3. The patient next steps on a chair about 18 inches high, five times in fifteen seconds timed by a watch. To make this test uniform, he stands with one foot on the chair at the count one; this foot remains on the chair and is not brought to the floor again until after the count five. At each count he brings the other foot on the chair and at the count "down" replaces it on the floor. This should be timed accurately, so that at the fifteen second mark both feet are on the floor. (*a*) Immediately, while he stands at ease, the pulse rate is counted for fifteen seconds; this is multiplied by 4 and recorded. (*b*) Counting is continued in fifteen second intervals for two minutes, record being made of the counts at 60, 90 and 120 seconds.

"The data from *a* will be scored by Part D, Table 1, taking the difference between this exercise pulse rate and the standing rate. The data in *b* are scored according to Part E, Table 1.

"This system of scoring men as to physical fitness is now being used by flight surgeons in their work among aviators, and is applied at the Medical Research Laboratory at Mitchell Aviation Field on Long Island.

"That there may be value in assembling the circulatory data under such a point system is indicated from an analysis of fifty-four cases of aviators who, when examined by the medical officers of the departments of the laboratory, were found to be ailing and physically below standard. The medical examinations included an overhaul by the internist, neurologist, ophthalmologist, and ear, nose and throat expert. The medical findings include a large variety of conditions, the majority being common to any group of men and in no way characteristic of aviators.

"That which was of greatest interest in this analysis was the final efficiency score of each patient. The distribution of the cases is shown in Table 2.

TABLE 2.—EFFICIENCY SCORE IN FIFTY-FOUR CASES

Points	No. of Cases	Per Cent.
0 or less	2	3.7
From 1 to 3	9	16.6
4 to 6	15	27.8
7 to 9	22	40.7
10 to 12	3	5.6
13 to 15	3	5.6
16 to 18	0	0.0
Total	54	100.0

"Only six of the fifty-four cases had a score of 10 or better, while 88.8 per cent. had scores ranging between 9 and −1. These figures seem to indicate that a score of 9 or less is characteristic of physically unfit men.

"On the assumption that a score of 9 or less gives indication that the clinician may find something wrong with the patient, we have listed all men among a group of 150 men who had a low score. In this group there were forty-six who scored 9 or less.

"The medical examiners working independently, and without the cardiovascular data available to them, recorded abnormal conditions in thirty of the forty-six men. Thus, when working independently, 65.2 per cent. of the group of forty-six with low scores by the cardiovascular efficiency test were found by others to be below standard. Two of the men were unfit because of excessive smoking, and one had recently been on a drunken spree. The neurologist reported five as stale and nervously unbalanced, the internist alone found five unfit, six were tonsil or local infection cases, and the remainder were found wrong by at least two of the medical departments.

"This point system of scoring men as to health and physical fitness by the cardiovascular reactions is easily applied. It has the advantage of stimulating men to attempt to improve the score by exercise and proper living. It is suggested that a score of 9 or less gives reason for an overhaul of the patient by a clinician. Aviators with a low score might well be called back for further examination and observation. A poor score suggests a search for a cause, The cause may be disease or unhygienic living." — C. K. Drinker.

WOMEN AND CHILDREN IN INDUSTRY

First Annual Report of the Director of the Woman in Industry Service for the Fiscal Year June 30, 1919. Woman in Industry Service, U. S. Dept. Labor, 1919, pp. 29. — Part I of this report, *Activities During the War, July 16 to November 11, 1918*, outlines the specific purposes and functions of the Woman in Industry Service, which was organized in July, 1918, presents the program proposed, and reports the action taken in each section of the program as follows: establishment of standards; recommendations relative to employment of women in hazardous occupations, night work, wages and industrial relations, and training.

The second part of the report on *Activities after the Signing of the Armistice* includes such questions as labor legislation, wages after the war, displacement of women workers, home work in Bridgeport, statistics of the employment of women, and the relation of women to the Peace Conference. A permanent status is urged for the Women's Bureau owing to the importance of the position of women in industry, and also an increase in resources to make possible more comprehensive work.

In the appendix, which concludes the report, there are set forth the standards recommended, among which are provisions in regard to hours of labor, wages, working conditions, home work, and employment management.—M. C. Shorley.

Special Provisions for the Health and Comfort of Women in Business. Nat. Assn. of Corporation Schools Bull., April, 1920, 7, No. 4, 157–159. — This is a report of data which have been collected relative to the special provisions made for the health and comfort of women in business. Among these are mentioned the following: the privilege to assemble later and leave earlier than the men workers; pensions at an earlier age and for shorter service; special women's service departments; the publication of special information booklets; the provision of medical service; day nurseries for the children of women employed; extra bathing facilities; and separate entrances. — G. E. Partridge.

Agricultural Education for Women in England. School and Society, July 31, 1920, 12, No. 292, 87–88. — "A meeting was held last month in London to establish the training of women as skilled agricultural workers on a national basis. . . . Never has the national need for scientific food production on the one hand, and for remunerative and healthy employment of educated women on the other been greater." It is proposed to extend the work of Swanley Horticultural College to meet the new requirements. — G. E. Partridge.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Control of Atmospheric Conditions in Hot and Deep Mines. Report of a Commission. Tr. Institute Mining Engineers (England), April, 1920, 58, Part 4. — In those places where the heat is not so great as to prevent continuous work, it may nevertheless be impossible for men to work at their ordinary rate without an abnormal rise of body temperature, so that the amount of work which they actually do is so small as to be economically unproductive. With an absence of air currents in deep mines there is a need for adequate ventilation with underground temperature control. The most hindering effects depend upon the degree of stagnation of air and amount of moisture present (wet bulb temperature) rather than the temperature there alone. The article presents a most interesting scientific discussion. — R. H. Greenman.

Detection of Organic Inhibiting Substances in Exhaled Air. *Gerhard Stroede.* Abstracted from Z. Schulgesundheitspflege, 30, No. 1; and Zentr. Biochem. Biophys., 1918, 19, 667, by H. S. Paine in Chem. Abstr., May 10, 1920, 14, No. 9, 1401. — "Using the Weichardt procedure with inorg. catalysts, S. investigated the presence of inhibiting substances in exhaled air, especially in school rooms. Colloidal Os was so affected by certain constituents of exhaled air that it suffered partial inhibition of its catalytic power of transferring O. The condition of the air in occupied buildings, rooms, etc., may be tested by this method. The above inhibition of the action of Os by exhaled air is produced to only a slight extent by the known chem. constituents of the latter. By taking absorption of CO into account in connection with this inhibition it can be shown with certainty that other inhibiting substances of unknown character are present in exhaled air." — W. O. Fenn.

The Elimination of Noises in Heating and Ventilating Systems. Heating and Ventilating Magazine, May, 1920, 17, No. 5. — In this, the first of a series of articles, the author points out that by careful designing and proper precautions many of the troubles found in heating and ventilating systems may be overcome. By the introduction of a vacuum system, doing without the valves, it is possible to eliminate the whistling of air. The nuisance of the water hammer is to be remedied by the prevention of condensation and by proper drainage. The water hammer sound is caused by steam rapidly condensing in contact with large quantities of water at a low temperature. The article makes other suggestions for the elimination of roaring in air ducts and resounding steam affected by engine pulsations, etc. — R. H. Greenman.

The Rural Supply an Integral Part of the Municipal Supply. *E. G. Birge.* Canad. Engineer, May 20, 1920, 38, No. 21, 490–491. — This article tells an old story in a new way. The author points out the possibility of the spread of an epidemic, such as typhoid fever, from one contaminated well existing on an isolated farm so that it endangers the whole community. The remedies suggested include better follow-up work by the state department of health, extension of the work of the American Water Works Association in standing for the best in water works practice, the establishment of district health officers and laboratories for the examination of water, etc., in rural communities, and action, such as that taken by the New Jersey State Board of Health in licensing water works operators. — R. H. Greenman.

A New Process for Neutralization and Simultaneous Reclamation of Corrosion Liquors. *Jungfer.* Zentralbl. f. Gewerbehyg., Jan., 1919, 7, No. 1, 1–5.— It has long been a problem how to reclaim the sulphuric acid and iron sulphate in the waste water from iron corrosion processes. During the war, when sulphuric acid was difficult to obtain, the bisulphate had to be used as a substitute. In this case there was no practical and inexpensive method for reclaiming the waste products, and plants which used this substitute were more or less forced to the unhygienic procedure of letting the waste water trickle or run off. Likewise, when sulphuric acid is used, there is no accepted method of purification of the waste products.

Hydrochloric acid can, however, be used. The waste water then contains ferrous chloride equivalent to about 4 or 5 per cent. uncombined acid. The author describes in detail the process employed for the last four or five years by the firm of Wolf, Netter and Jacobi, whereby the iron and hydrochloric acid are

both reclaimed. The reaction $FeO+2HCl = FeCl_2+H_2O$ is a reversible one if superheated steam is passed into the ferrous chloride. By this method 90 per cent. of the chlorine content of the washing solution is obtained, and can be used over again in the industry. The iron oxide can be sold for forging.

The question of removal of waste water in this case is solved not only from the standpoint of hygiene, but also from that of economy. Through the practical arrangement of the plant, which essentially works automatically, hydrochloric acid is obtained at less than half the present market price. — M. D. Ring.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Your Housing Problem. Ideas for Meeting It, Drawn From an Investigation Among 1,000 Industrial Concerns. Factory, May 1, 1920, 24, No. 8, 1317–1323. — This discussion represents the result of a study of housing as it has been developed by fifty concerns located in some fifteen states. The housing developments considered range from a one-house project to projects involving accommodations for several hundred families. Only three of the concerns included in the study reported that they had abandoned their housing work because it did not pay. Of the twenty concerns making a definite answer on the question of labor turnover, only one indicated that housing had not reduced turnover and tended to increase the efficiency of the workers. Of the group of fifty concerns, about half had organized subsidiary companies to carry on their building operations.

In speaking of types of buildings, the report discusses in some detail the Ingersoll concrete house. This form of construction has met with success recently in Union and Phillipsburg, N. J. It has the advantage of moderate cost, attractiveness, and adaptability to rapid construction. In Phillipsburg one of these four-room houses costs $2100 complete. The cost of the land is not included in this figure. A record of forty-eight hours has been set for erecting the walls and putting in rough floors in an Ingersoll type of house. While the lines are simple, and standardized, variations may be obtained by different porch construction.

The experiences are cited of several companies which have undertaken housing effectively on a large scale. Among these companies are the Youngstown Sheet and Tube Company, the Whiting-Plover Paper Company, the Norton Company, and the Connecticut Mills Company. The plan of the Norton Company for selling homes to its employees is given in some detail. One interesting feature of this plan is the detailed statement provided each purchaser explaining how much he owes and how his payments are to be made. — C. H. Paull.

Health Center for Norfolk. Survey, March 13, 1920, 43, No. 20, 739–741. — This is a brief outline of a plan for a health center in Norfolk, Virginia. The buildings in the health center are to include a prenatal building, juvenile courthouse, emergency hospital, administration building, detention home, and general medical building. Perhaps the most characteristically social element of the work of this health center is to be connected with the activities of the prenatal building. This building is to be attractively decorated throughout and on one of the upper floors is to be a model flat. Special lectures are to be arranged for. — C. H. Paull.

Removing Social Barriers by Zoning. *Charles H. Cheney.* Survey, May 22, 1920, 44, No. 8, 275–278. — As a basis for his discussion of a zoning plan for cities, the writer cites the Portland (Oregon) scheme. Believing that the one family home has the greatest social value, provision has been made to restrict the building in two-thirds of the city area to single family dwellings. The congestion in these restricted portions of the city will approximate eight to twelve families per acre. Such a zoning scheme as that proposed for Portland will not bar business block or apartment house building. Business districts are arranged for within easy walking distance of the single family zones. Apartment house districts are similarly provided for.

"Zoning must be flexible, not rigid, and reasonably easy of amendment." Public needs change, and with these changes should come wise readjustments from time to time in the restrictions placed upon the zones affected. — C. H. Paull.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Wages and Hours of Labor in Cotton-Goods Manufacturing and Finishing, 1918. U. S. Bur. Labor Statis., Bull. No. 262, Nov., 1919, pp. 147. — Earnings per hour, hours of labor per week, and full-time and actual weekly earnings in the cotton-goods manufacturing and finishing industry of the United States for the year 1918 are presented in this report. Separate figures are shown for manufacturing and finishing. Comparable figures are shown for 1916, and summaries for each year, except 1915 and 1917, from 1907 to 1918 for cotton-goods manufacturing and from 1911 to 1918 for cotton-goods finishing are also shown. — M. C. Shorley.

Welfare Work for Employees in Industrial Establishments in the United States. U. S. Bur. Labor Statis., Bull. No. 250, Feb., 1919, pp. 139. — The field work of the investigation reported in this bulletin extended over a period of twelve months, in 1916 to 1917, and thirty-one states were visited in connection with the study.

In Chapter I on *Health Measures for Employees*, the findings are reported relative to (1) medical, hospital, and surgical treatment, including first-aid equipment, system of following up absentees, average number of cases treated, construction and equipment of standard emergency hospital, dental and other special work, physical examination on entrance, periodic physical examinations, company hospitals, cost of treatment to employees, treatment of tuberculous employees, and medical fees; (2) rest periods; and (3) vacations and sick leave.

Among the subjects included in subsequent chapters are: drinking-water systems; washing-up and locker facilities; lunch rooms and restaurants; indoor and outdoor recreation; education; disability funds, pensions, and group insurance; administration of welfare work; and social betterment among employees' families. — M. C. Shorley.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Changes in Some of Our Conceptions and Practices of Personnel. *W. D. Scott.* Psychological Rev., March, 1920, 27, No. 2, 81–94. — "Those of us who are engaged directly in personnel administration in such organizations as educational institutions, the army, the navy, industry and commerce, use the term personnel administration to include securing, testing, selecting, hiring, placing, training, supervising, disciplining, stimulating, directing, transferring, discharging, and promoting each individual concerned; and in developing the *morale*, increasing the *esprit de corps*, and creating and sustaining a contented and efficient group of individuals." The author discusses changes that have taken place in our conception of *personnel* work as a problem and practice in the above sense, especially the change in point of view by which we now treat men in groups, less as reasoning men and more as controlled by sentiment. Industrial groups, for example, are influenced as much by pride and by sentiment as by the logic of the greater gain. There are also changes in our conception and practice of education, as we take more the behavioristic point of view and define education as profiting by experience. The mechanic at the bench is receiving an education if he is profiting by his experience. In planning his training program the personnel director is coming to see that his responsibility is not met by providing formal classroom continuation school instruction; he must supply each employee with richness of experience, and see that he profits continuously by his experiences as an individual worker, as a member of the entire body of employees, as a prospective junior executive, as a member of a family, and as a citizen of the state. The biological relationship existing between the worker and his work must be emphasized. The writer objects to the variety of industrial psychology which starts with the intention of analyzing man and job for the purpose of making as close a fit as possible between the two. The right idea is rather to regard man and job as a living progressive situation; we must think of functional unity. Personnel work involves the shaping of the growth of this productive complex in forms of greatest economic effectiveness and ultimate social value.

The idea of vocational guidance has also been undergoing change. During the past few years

fairly adequate job analyses have been made of most positions in many of our industrial and commercial organizations. Great advance has been made in our understanding of human nature. We are in the way of doubling the productive power of the human race by these new scientific methods. Such an increase in the efficiency of the race will probably be due to further increase in our knowledge of personnel rather than to further increase in our knowledge of the material universe. — G. E. Partridge.

Trade Unionism and Temperament. The Psychiatric Point of View in Industry. *E. E. Southard.* Ind. Management, April, 1920, 59, No. 4, 265–270. — The writer of this article believed he had found a relation between types of unionism as outlined by Hoxie and functional types of temperament as classified by the ancient Greek physicians, Hippocrates and Galen.

Temperaments	*Types of Trade Unionism*
Phlegmatic	Business Unionism
Sanguine	Uplift
Melancholic	Revolutionary
Choleric	Predatory

The phlegmatic type, it is pointed out, represents the average individual who accepts pleasure and pain with relative indifference. This person is apt to affiliate himself with the more conservative type of business trade union. Although it is doubtful whether any single union is definitely an uplift type, craft and industrial unions often express the uplift idea. The sanguine individual, who, according to the modern psychiatrist, is subject to an opposite feeling, the "blues," is attracted by the uplift idea.

There seems to be a definite relationship between the melancholic temperament and the revolutionary type. The confirmed melancholic is apt to center his thought upon certain things until his mental processes amount to delusions. There is an apparent coincidence between this state and the passivity and unpleasant emotional tone of the revolutionary unionist.

The choleric temperament seems characteristic of the predatory type where there is little evidence of the high intellectual levels of the revolutionary type. With the predatory unionist, the action of the individual is dominated by instinct. He acts upon impulse. — C. H. Paull.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

Volume II — OCTOBER, 1920 — Number 6

CONTENTS

GENERAL

The Hours of Work Problem in Five Major Industries. Nat. Ind. Conference Board Pub., Research Report No. 27, March, 1920. — This report is a useful summary of five previous reports upon the hours of work problem in five industries, namely, cotton, wool, silk, boot and shoe, and metal manufacturing. All of these individual reports have been abstracted in the Journal of Industrial Hygiene and attention need now be given only to the two new features which the report introduces.

1. *Hours of Work and Social Factors.* — The proper length of the working day cannot be determined through studies of production, fatigue, health, or any single factor. "Other so-called social factors, that is, the need of sufficient time for recreation, amusement, home-life, and self-development must also be taken into account. . . . These social factors have repeatedly been emphasized by students of labor problems." The fact that the leisure of the worker is often spent unwisely does not vitiate the broad general principle that "no schedule of work should be regarded as acceptable which does not allow reasonable leisure for domestic companionship, rest, recreation, and the general requirements of good citizenship." It is then brought out that shorter hours of work must afford better opportunities for the Americanization of foreigners and for kindred results of equal value but it is likewise held that society to progress must produce in excess of immediate wants "so that there shall be a surplus of capital for the undertaking of new projects, for the acquisition of more things which contribute to well-being and to the enjoyment of more pleasures." Production thus makes possible all the advances which we can consider most desirable, and in the end studies of the hours of work problem must concern themselves with the numerous interrelated

factors which are concerned with production and must not dwell upon single phases of the problem.

2. *The Shorter Week-Day and Unemployment.* — Several opinions from labor organizations are cited which maintain that reduction of hours must remedy unemployment and it is acknowledged that as a temporary expedient such a course may be useful. It is, however, held that there is an essential bond between production and employment. Reduce hours and reduce production, increase thereby the cost of the article manufactured with consequent loss of sales, and a vicious circle is entered which, in the end, makes only for more unemployment. "A more constructive policy would be to seek a better adjustment of industrial effort, so that every worker may be employed where he is most needed, seasonal fluctuations may be reduced as far as possible, and the means of distributing finished products more nearly perfected. Even under abnormal conditions this policy of reducing hours to relieve unemployment is at best an expedient of only doubtful value. Moreover, such a policy, particularly in times of high prices and depleted supplies, would prove seriously detrimental to the best interests of the workers and of the public in general." — C. K. Drinker.

Minimum Quantity Budget Necessary to Maintain a Worker's Family of Five in Health and Decency. U. S. Bur. Labor Statis., Month. Labor Rev., June, 1920, 10, No. 6, 1–18. — This budget, recently prepared by the Bureau of Labor Statistics, is discussed under the following headings: Food; Clothing; Housing; Heat and Artificial Light; Furniture and Furnishings; Miscellaneous. — R. B. Crain.

Occupational Diseases among Porcelain Workers. *F. Koelsch.* Zentralbl. f. Gewerbehyg., March, 1920, 8, No. 3, 41–45. — The author reports the results of investigations made on 1000 porcelain workers, half of whom were men and half women, almost all of average physical development, strength and nutrition. Dust plays the chief rôle in producing disease. Frequent signs of irritation of the connective tissue of the eye, especially catarrh, were found. These were most numerous in the workers in the firing house and in the glaziers.

Chronic nasal and pharyngeal catarrh, and occasional nasal polypi and diseases of the middle ear were noted. Most common were complaints referable to the upper and lower air passages, catarrh of these passages, short breath, and general asthmatic conditions. In about half of the cases symptoms were found which could only be interpreted as arising from dust deposits in the lungs. In general, men were more often affected in this particular than women, probably owing to the fact that they averaged greater length of service. Two per cent. had pulmonary tuberculosis.

Many complained of stomach disturbances and loss of appetite due to continual swallowing of dust. There is a possibility of ventricular ulcers. Other writers are cited who have similar findings among workers in porcelain and cement dust.

The rheumatism found is probably of climatic origin. Minor ailments are noted as, for example, abrasion of the epidermis of the finger pads, and pains in the abdomen, especially among old women, resulting from heavy lifting. — M. D. Ring.

Annual Report of the German Factory and Mine Inspectors for the Years 1914–18. — For the last five years there has been an almost complete suppression of news about industrial hygiene in Germany, formerly so rich a field for articles on this subject. Scattered reports of the effects of the war on the workers, especially the effect of hard physical labor on women, came to us from time to time, and toward the middle of 1918 the British allowed the National Council of Defense to see some photographs of articles written by Koelsch of Munich on poisonous explosives, but these had necessarily a very limited circulation. It is, therefore, with great interest that we welcome three bulky volumes of the Factory Inspection Reports for the German Empire which cover the four years of the war. There is much matter deserving of study in the sections on wages, hours, child labor, women's labor, accidents, and so on, but this article must be confined to the industrial diseases alone.

The German method of presenting these reports has always been irritating to the foreign reader because of its apparent lack of editorship. Each district inspector sends in his report, covering all of the regular subjects, but nobody brings the separate reports together into a comprehensive whole. It has always been quite impossible, therefore, to discover

how much lead poisoning there is in Germany in proportion to the numbers employed in lead industries, and how many cases are serious, how many mild. No comparison can be made between a lead trade in Germany and the corresponding one in England, because the statistics for Germany are not summarized and presented in usable form. This might be overcome by a careful study of each report if they were uniform, but they are not. For instance, take dinitrobenzene poisoning during the war. The Düsseldorf inspector reports his cases on the basis of men and women employed in dinitrobenzene, but gives only the deaths, not the non-fatal cases, while the Wiesbaden inspector gives all cases, fatal and non-fatal, but does not give the numbers employed in such work. Moreover, the reports of many inspectors need a medical editor and their value would be greatly enhanced by his work. We Americans, however, are the last people who have a right to criticize — we who have only begun in a few states to collect and publish the facts about industrial diseases.

Germany's experience with the war industries was in many ways similar to that of the other belligerent countries, but in other respects it was quite different. The features of industry common to all the fighting countries were these. The working force was composed of women and young persons unaccustomed to heavy work, of men from sedentary occupations, of the old, and the physically handicapped; new and dangerous industries were begun — making and loading of explosives and war gases; war plants were hastily constructed in poor locations, with insufficient accommodations for washing, bathing and eating, without proper dust-removal apparatus and other safeguards; speed in production was insisted on at the expense of the health and safety of the workers; there was an enormous labor turnover so that a continual stream of untrained and unselected workers passed through the factories; and finally the influenza epidemic of 1917 made great inroads on the working force in all the warring countries.

But besides all these disease producing factors which were to be found in the allied countries as well, and in our own country for fully two years before our entrance into the war, Germany had other handicaps, far more serious. The effect of the blockade stands out on every page of this report. While in Great Britain and France the health of the munition workers on the whole improved, in spite of long hours, because the increased wages enabled them to buy better food than ever before, in Germany the food blockade resulted in a progressive loss of strength which is shown again and again in the sickness records given by the factory inspectors. In a Breslau textile factory the cases of sickness among the men rose from 19.1 per cent. in 1913 to 39.3 per cent. in 1918, and among the women the increase was from 30.9 per cent. to 88.6 per cent. Sometimes the record shows an initial fall in the sickness rate, before the blockade, under the influence of high wages and good food, followed by a rise both in frequency and severity of sickness as the war went on. This is shown in the following record of a Dresden factory employing between 8000 and 9000 men and women.

Year	Sickness per 100 Employed	Per Cent. of These Incapacitated
1914	73.8	26.3
1915	68.6	21.4
1916	71.0	23.3
1917	85.0	34.9
1918	95.0	54.2

Thus not only was the number of the sick larger but the severe forms of sickness were doubled. The increase occurred especially in the digestive diseases and in inflammations and suppurations, the latter being responsible for only 7.9 per cent. in 1913 and 13.1 per cent. in 1917.

Saxony had apparently little to do with explosives but much with the machine and metal industries. The inspector for the Leipzig region states that much more harm was caused by lack of food than by long hours and night work, as shown by the fact that the non-industrial population had as much ill health as the industrial. Sometimes, indeed, the factory workers, especially those engaged in heavy work, were in better health than the rest of the population because extra rations were allowed for especially strenuous jobs. Actual industrial diseases were diminished in Saxony, general diseases were increased. The miners of the Freiberg region suffered very much from lack of food in that bleak and barren country where so little can be produced from the soil. The failure of the potato crop of 1916 forced the Germans during the winter and spring of 1916–1917 to subsist chiefly on turnips for

months at a time. This "Kohlrüben Winter" left unmistakable traces on the sickness and mortality rates. In Chemnitz the general death rate, the rate for tuberculosis and that for the aged rose as follows:

Year	General Rate per 10,000	Tuberculosis per 10,000	Over 60 Years per 10,000
1913..........	136.7	12.64	166.0
1916..........	130.4	13.32	264.0
1917..........	170.4	23.63	471.0

During that winter it often happened that both men and women factory workers had to give up from exhaustion or were overcome while at work. Married women with young children suffered most. There was a rapid and striking increase in tuberculosis. In one large typewriter factory in the Chemnitz region during 1918, from forty to fifty persons a week, out of a force of about 4000, had to quit work because of tuberculosis. In spite of the erection of factory kitchens to supplement the government rations and in spite of increased wages, malnutrition and the resulting exhaustion grew constantly worse during the third and fourth years of the war, and when in the fall of 1917 the influenza spread among these depleted people, some factories were obliged to close down. Mention is made of three epidemies of influenza and one epidemic of dysentery, in 1917, perhaps connected with the turnip diet.

A second effect of the blockade was the lack of soap and of protective clothing, rubber gloves and boots, waterproof aprons, and later of even ordinary underwear and overalls. Soap was strictly rationed and although on recommendation of the factory inspectors this ration was increased for workers in poisonous substances, still it was not only insufficient but most unsatisfactory. The soaps used were irritating, caustic. We are told that laundry workers suffered from the effects and there was no way of protecting them. In the soap factories inflammation of the eyes appeared for the first time, caused by the large amount of alkali in the soap. The officially approved formula for soap powder was as follows:

Fatty acids..................	4.5 per cent.
Soda..................	30.0 per cent.
Sulphate..................	5 to 10 per cent.
Water glass..................	10 to 15 per cent.
Kaolin..................	0.5 to 1 per cent.

Another effect of the blockade was the lack of fuel which kept the working rooms cold and prevented proper ventilation. Sometimes employers tried to heat with open coke burners, causing dangerous contamination of the air with carbon monoxide. Lack of rubber and other raw materials prevented the replacement of such important apparatus as suction fans for dust and fumes. Finally the blockade shut out many of the chemicals which Germany had always used and for which substitutes had to be found. These substitutes were sometimes more dangerous than the original material, sometimes so unfamiliar to the people using them that damage occurred before proper precautions were instituted.

Much the most troublesome of these substitutes were the mixtures of high-boiling coal tar oils, sometimes containing creosotes, which were used to take the place of the machine oils and lubricating compounds formerly derived from petroleum. Germany has no petroleum, and the "Ersatzschmieroele" which were put on the market seemed to have caused more industrial sickness and disability than any other single substance. In one plant using an oil which contained creosote, there were 200 cases of dermatitis, fifty of them lasting long enough to be classed as occupational accidents. Every report emphasizes the trouble occasioned by these oils. The evil was increased by lack of oil-proof material for gloves and aprons, for the clothing would get saturated with oil and the eruption spread all over the body. Ulcers would form and cause weeks of disability with feverishness and general malaise. The lack of neutral soaps then became very distressing, the war soap only adding to the irritation of the skin. Naturally there was no vaseline, nor do other bland ointments seem to have been abundant.

Eczemas and other forms of skin disease were also caused by the use of anthracene and naphthalene to impregnate wood for railway ties and telegraph poles. The men who carried these on their shoulders would get their clothing saturated with the oily substances. Leather substitute for shoes was made by soaking pressed paper in a tarry mixture, and here, too, there was skin disease. More serious trouble followed the use of benzene (benzol) to take the place of turpentine and linseed oil, both of which apparently have always been imported by Germany. Men using these benzene paints and varnishes suffered much from the fumes, especially when painting small spaces like those

in torpedo boats. In the Stettin region, where such boats were built, the attempt was made to drive the fumes out with a stream of compressed air, but even so it was found to be unsafe to allow the men to do this work in the summer more than half an hour at a time. In one factory, solvent naphtha (a mixture of crude toluene and xylene) with a high acetone content was used as a paint thinner, and in one day twelve of the women employed fell sick, four the next day and three the third day. The women acted as if they were drunk; they became irrational, then staggered or fell to the floor with convulsive twitchings. The effect passed away, however, and in a few days they were able to return to work.

Sometimes carbon disulphide was used as a thinner for varnish or lacquer and gave a good deal of trouble. Carbon tetrachloride was used as a mordant for skins, and in one military establishment it caused symptoms of drowsiness, confusion, anesthesia. Wood alcohol, with a strong acetone content, was used as a substitute for grain alcohol, and inflammation of the eyes was attributed to its action.

Of the familiar trade poisons, lead gave less trouble than ever before. There was no raw material for the white lead plants and they closed down. Lead paint was no longer made. The pottery work which required lead glazes was also abandoned almost entirely. On the other hand, arsenical poisoning increased. Finely powdered metallic arsenic was used for "certain purposes," and the effect on the statistics of arsenical poisoning in one factory, as shown below, is quite striking:

Year	Number Employed	Cases of Arsenic Poisoning
1913	107	7
1915	64	25
1917	137	111

This increase is attributed to the necessity for increased production, the impossibility of replacing the dust-collecting apparatus when it got out of order, the lack of proper protective working clothes and of sufficient clean underwear, and the shifting labor, unskilled and uninstructed, many of them war prisoners. War industry also increased mercurial poisoning, for the demand for acetone led to its production in large quantities from acetylene by means of metallic mercury, which was oxidized and then reduced over and over again.

Several substances are described which are not known in American industry. For instance, trichlorethylene was used to clean metallic surfaces instead of naphtha or gasoline. It caused nausea and drowsiness and confusion, so that the susceptible workers had to give it up. Another new substance, perchlornaphthalene, was used to impregnate fabric for gas masks. It was tested by the pharmacologists and pronounced harmless, but it proved to be not only very irritating to the skin, causing confluent ulcers, but also to cause weakness in the legs, uncertain gait. The fumes as well as the dust set up skin lesions and even daily baths did not serve as protection against it. In one plant employing ninety persons there were fifty cases in a space of nine months. In another factory an excellent exhaust apparatus carried off the fumes, but unfortunately spread them over the countryside so that, though the workers were protected, the cattle in the region fell sick and had to be slaughtered, and it was necessary to move the factory to a site where no such harm could be done. It is said that the ulcers caused by "Perna," as perchlornaphthalene was called, yielded promptly to a few exposures to artificial sunlight (Höhensonnenstrahlapparat).

Bakelite, phenol-formaldehyde, used in the United States as a substitute for hard rubber, is known here to set up a dermatitis in the men who make it. In Germany it was heated for use as a lacquer, and the fumes which were given off made women faint. Calcium cyanamid, which was found both by the French and the Americans to be excessively irritating to the skin, is mentioned by Koelsch as one of the war poisons. Among those that were manufactured for use in gas warfare, it is noted that phosgene caused many slight attacks of respiratory disease, and eight deaths from accidental escape of the fumes. Methyl bromide proved to be not only a tear gas but also a poison to the central nervous system. The explosion of a copper kettle resulted in scattering 125 kg. of methyl bromide about. After the room was supposedly thoroughly aired the workmen were allowed to go back. Four of them sickened on the following day, and one died on the third day. Then, after the lapse of two weeks more, work was again resumed and six men fell sick, two of them dying. The inspector believed that fumes of methyl bromide were escaping

from a leak, and the weak odor of methyl bromide was masked by stronger chemicals. No description is given of the symptoms in these cases.

The Germans had their first cases of poisoning from the solvent used for cellulose acetate in airplane manufacture as early as the latter part of 1913. They traced the trouble to tetrachlorethane and after some nine or ten cases of toxic jaundice had developed from this source, the use of tetrachlorethane was forbidden by law, so that the Germans escaped the very serious trouble with airplane dope which the British experienced in the early days of the war. There were seventy cases of toxic jaundice in British airplane manufacture with twelve deaths, before a substitute for this poisonous solvent was found. The solvent used by the Germans, however, was not free from lesser toxic properties, and three or four inspectors report the occurrence of headache, general malaise, faintness, confusion, nausea, loss of appetite, and dizziness among the women using cellulose acetate dissolved in wood alcohol and other solvents, such as ketones, chloroform and formic ether. The production of formic acid fumes from the latter caused irritation of the eyes and nose.

A quite unexpected source of occupational poisoning proved to be the dehydration of vegetables, which was done on an enormous scale; in some places the heat was produced in coke ovens and carried with it carbon monoxide and sulphuretted hydrogen. In one such plant there was 11.1 per cent. of sickness among the employees and in another, 20.5 per cent., while the average for the *Krankenkassa* for that region was only 4 per cent. There was a difference of opinion as to the cause of this increased sickness rate, some physicians holding that it was not caused by carbon monoxide but by the chilling effect of leaving the dehydrating rooms for cold rooms. As precautions, however, proper fuel was ordered, careful firing, and good ventilation; youthful labor was forbidden; and a night shift of only eight hours prescribed.

The most interesting part of the report is that dealing with the manufacture and loading of explosives. Industrial disease was, of course, increased at once as a result of the handling of these new poisons. For instance, a comparison is made between two plants, one of them a machine shop, the other handling explosives, and the rates of sickness for the two are given.

	Metal Works		Explosives	
	Employing in 1917 { 4320 men, 2500 women		Employing in 1917 { 340 men, 620 women	
	Men	Women	Men	Women
Skin diseases......	2.1	3.8	11.7	9.7
Respiratory diseases	5.3	9.2	10.3	10.5
Digestive diseases..	3.8	8.5	9.0	28.7
Blood and blood vessels.........	2.3	18.6	1.4	20.5

The rate increased as the war progressed, rising in a Düsseldorf plant from 67.7 per cent. among the men in 1914 to 101.5 in 1918. The principal centers for the manufacture and loading of explosives seem to have been Potsdam, Düsseldorf, the Wiesbaden region and the region around Munich. There seems to have been very little of this work done in Saxony.

The explosives used in Germany were trinitrotoluene, picric acid, dinitrobenzene, trinitranisol, trinitronaphthalene, fulminate of mercury and the nitro powders. Her experience with munition poisons was quite different from that of France, or of Great Britain, or of the United States. In France the favorite high explosive for shells was a mixture of picric acid (trinitrophenol) and dinitrophenol, and it was the latter which gave rise to almost all the serious poisoning in French explosive works. Germany had some slight trouble with dinitrophenol, but apparently it was made only in the course of the manufacture of picric acid, and as this was used only for detonators the amounts handled were small and there was not much exposure to dust. The Germans look upon picric acid as only slightly poisonous, causing usually nothing worse than dermatitis; more rarely systemic symptoms, such as irritation of the throat, digestive disturbance and anemia. Women are said to be more susceptible to it than men.

The favorite high explosive in Great Britain and the United States, trinitrotoluene, was used in Germany at the beginning of the war, but apparently not enough could be obtained, for at the end of 1916 they began to supplement it with dinitrobenzene. In British shell-loading plants there was a great deal of poisoning from trinitrotoluene, and the toxic jaundice characteristic of this form of poisoning was soon made notifiable; no less than 346 cases with ninety-six deaths were reported to the Home Office. In the United States not only the shell-loading plants, but also the manu-

facturing plants for T.N.T., had a great deal of poisoning—how much, our faulty methods of factory control make it impossible to say. In Germany as in France, trinitrotoluene was considered one of the milder poisons, provided it was pure. In neither country did the pure substance give rise to serious poisoning, even when, as in Germany, it was mixed with ammonium nitrate. The use of this mixture, known as amatol, in the United States and in England had the effect of increasing T.N.T. poisoning, because ammonium nitrate is hygroscopic and keeps the skin of the workman's hands and arms moist and permeable.

Koelsch reports on T.N.T. in the Bavarian factories. He says that they had only light cases of poisoning, cyanosis, headache and nausea, except when it was contaminated with tetranitromethane. He attributes to the latter three serious cases of pulmonary edema, with one death. There was no case of toxic jaundice in Bavarian loading plants. The report from Potsdam, however, is not so favorable. Up to the end of 1917 there had been seven deaths from toxic jaundice, but these occurred all in one factory at one period, and after that there was no more toxic jaundice reported, so that the inspector believes that the T.N.T. in use at that time was probably contaminated with tetranitromethane. There were also seven cases in 1917, and a few in 1918, of catarrh of the intestines, gastric hemorrhage, bronchitis, cardiac neurosis and anemia. In Wiesbaden large quantities of T.N.T. were made, but there was no sickness in connection with it, and only mild cases in the loading plants. In the Magdeburg region one girl died of T.N.T. poisoning, and it is said that the girls employed there were very pale and looked older than they were.

The number of cases — mild, serious and fatal — of T.N.T. poisoning is not given anywhere, and but passing mention is made of twelve deaths from toxic jaundice. One of these was in a little girl of 14 with organic heart disease, who became cyanosed after two days' work and died shortly after — a striking instance of the way all standards as to the employment of the young and the handicapped in dangerous work were thrown overboard during the war.

Trinitranisol was evidently used by the French for they found it to be almost as dangerous a poison as dinitrophenol. The Germans used it a good deal, and the workers suffered terribly from skin diseases, women and alcoholics being especially susceptible. Sometimes poisoning followed a few hours' exposure, and the face was swollen, burning and itching; later the eruption spread to the whole body. In one plant in the Rhineland thirty out of forty women suffered in this way. Fulminate of mercury does not seem to have caused as much dermatitis as in England and over here; certainly it was not nearly so troublesome as trinitranisol. Mention is made of fumes of nitrogen oxides and nitrous ether in the manufacture of fulminate.

The greatest single cause of sickness and death in American explosive works was the evolution of nitrogen oxide fumes in the production of gun cotton and picric acid. In England also there were a good many cases of nitrous fume poisoning. French munition plants, apparently, were free from this danger, and there is little mention of it in the German reports. The one from Wiesbaden speaks of four nonfatal cases, and the one from Nürnberg-Fürth of eight cases. For anyone knowing conditions in American gun cotton works and picric acid works, it is hard to understand how Germany escaped with so little trouble from the nitration processes, when we had so much. Ether poisoning is not mentioned in connection with smokeless powder manufacture, which makes one infer that the German method calls for some other solvent than ether. Nitroglycol was used apparently in mixed powders instead of, or in addition to, nitroglycerine and is said to volatilize more than the latter; but the symptoms are apparently the same. Trinitronaphthalene, when used in powder form, set up inflammation of the eyes and mucous membranes, but not after the producers began to granulate it instead of powdering it.

The chief poison in German munition works was dinitrobenzene, and most of the reports deal very fully with it, for wherever it was used it caused far more sickness and death than any of the others.

The danger with D.N.B. is from fumes, but far more from contact. In Bavaria from 1915 to the end of the war there were fully 1000 cases of D.N.B poisoning and many of the victims had from two to five attacks. There were, however, only twelve deaths. In one factory the cases of poisoning reported averaged — calculated on the basis of the average payroll — 14.7 per cent. in 1917. The maximum, 30.8 per cent., came in summer; the

minimum, 2.3 per cent., in late fall. Another factory, situated in a windless hollow, had a maximum of 69.7 per cent. in August and a minimum of 13.3 in November.

The districts reporting cases of D.N.B. poisoning are Potsdam, Bavaria, Düsseldorf, Wiesbaden, Oberpfalz, Oberfranken, Ludwigshafen. In Düsseldorf there were eighty-one deaths — seventy-one men, ten women. These were during five years, as follows:

Year	Number Employed		Deaths	
	Men	Women	Men	Women
1914	660	130	3	..
1915	1603	710	7	..
1916	1516	873	10	1
1917	1998	1315	25	6
1918	2209	900	26	3

No mention is made here of the non-fatal cases, while in the reports from the other regions all cases are enumerated, but the numbers employed are not given, so that no summary can be made of the proportion of sickness and of death among D.N.B. workers in Germany. In four regions, excluding Düsseldorf, there were altogether 1923 cases of poisoning and twenty-two deaths. Adding the Düsseldorf figure of eighty-one, and six from Wiesbaden and four from Breslau, there seem to have been altogether 113 deaths from D.N.B. These figures are simply collected from the different reports and it is possible that some have been overlooked. Whether the Düsseldorf region had more such work than all the others put together, or had much worse conditions, is not stated and no explanation is given for these eighty-one deaths. The proportion of cases of D.N.B. poisoning among women was greater than among men: in 1916 it was 66 per cent. as against 56.7 per cent. for men; in 1918, 119 per cent. as against 100.5 per cent. One of the Wiesbaden plants had to close down because of "anilismus" (cyanosis, headache, dizziness, faintness, etc.) among its force. The inspectors state that, in contrast to the other explosive poisons, practically everybody seems to be susceptible to D.N.B.

The symptoms of D.N.B. poisoning are: general malaise, sense of weariness, loss of appetite, itching, roaring in the ears, dizziness, fainting, palpitation of the heart and sleeplessness. The lips become blue, with marked pallor of the face; there is sweating, vomiting, cramps, swelling of the legs, difficult urination, and, in women, paralytic symptoms. No description is given of the fatal form.

The inspectors seem to have made valiant efforts to safeguard their charges against the effect of these new and unfamiliar poisons but their difficulties increased as the war went on, even though the knowledge gained of the nature of the poisons was a help. But soap grew scantier and poorer, rubber gloves were unattainable, even stuff for aprons was hard to get. The employees were more and more unfit to stand the exposure to poisons — exhausted women, old and sick men, young girls and boys. Finally, the food blockade, which was more stringent each year, and the terrible influenza epidemics all combined to render the workers defenseless against attack from poisonous fumes and dust. Yet a great deal was done to help. The food ration was the largest that was allowed, and in addition many factory owners installed their own kitchens and lunch rooms. Milk was somehow procured and given free to workers in D.N.B., picric acid and T.N.T. Because poisoning was so much increased in hot weather, Koelsch in Bavaria had the hours of work changed so as to avoid the hottest part of the day, from 10 in the morning to 4 in the afternoon, and to utilize the early and late coolness. In one plant during the rest periods milk was given and regular oxygen inhalations, which were considered of decided benefit. In a loading plant in the Rhineland for D.N.B. and trinitranisol, they succeeded in making almost all the work mechanical and the work benches were provided not only with suction fans to carry off fumes and dust, but with a stream of compressed air. In a plant in Bavaria the D.N.B. was conveyed in closed pipes and discharged into closed receptacles, yet even here four deaths from poisoning are recorded. Although in most places the washing facilities, lunch rooms, and so on are said to have been insufficient, the famous plants of Friedrich Bayer and the Krupp works were complete in every detail. — Alice Hamilton.

Opportunities for the Study of Industrial Medicine in the United States. *Augusta Shuford.* U. S. Bur. Labor Statis., Month. Labor Rev., May, 1920, 10, No. 5, 142–154. — "This article is based mainly upon answers sent to the heads of medical colleges and of the medical faculties of universities inquiring as to the facilities offered by educa-

tional institutions and in clinics for the study of industrial medicine. No attempt is here made to give an exhaustive list of educational institutions including industrial medicine or hygiene in their curricula or of clinics specializing in the treatment of industrial diseases or accidents, but merely to present a substantially true picture of the situation regarding the facilities offered for the training of industrial physicians by noting the most conspicuous work being done along this line and citing typical but less ambitious efforts." — R. B. Crain.

A Factory University. School and Society, July 3, 1920, 12, No. 288, 23–24. — In its recently opened industrial university, the Goodyear Tire and Rubber Company is undertaking the education of more students than the University of Wisconsin. It has an enrollment of 6200 and a faculty of 117 members. Classes are in session from 7 A.M. to 11 P.M. The subjects range from grade-school studies to post-graduate technical studies. There are several branches: Americanization, production, commerce, sales, and household arts. Special attention is given to apprentice courses for machinists and for draftsmen, and in these courses there has been an attempt to work out the best combination of shop work and school work. — G. E. Partridge.

Industrial Training; What Shall We Subtract, and What Shall We Add, in the New Century of the Education of the Deaf? *J. Stuart Morrison.* Am. Annals of the Deaf, May, 1920, 65, No. 3, 213–224. — Because of the great changes that have taken place in industry everywhere, due to the introduction of machinery, the tendency is for rapid drift toward the city. Agriculture, for these reasons, is a poor subject for the industrial training of such classes as the deaf. It is useless to teach trades in which the demand is slight. We must eliminate, too, such forms of manual training as do not lead directly to trade teaching. Omit all antiquated methods of doing things. Leave out the hand-made in every case in which the machine-made is superior, unless hand-work is necessary introduction to work with the machine. Do not try to do too many things passably well. Add to the curriculum any trade for which there is a large or growing demand. Make close co-ordination between the classroom and the workroom. Put in every piece of machinery necessary to make the shop modern. — G. E. Partridge.

Opportunities Open to the Textile School. *H. W. Nichols.* Educational Rev., April, 1920, 59, No. 4, 332–341. — The lack of interest in their work manifested by many employees in the cotton mills of Massachusetts has led several superintendents to co-operate with the textile schools by giving scholarships or paying for the education of capable boys. There are three classes of students that may be attracted to a textile school: (1) the student who wishes to learn to operate some one machine; (2) the person already employed as an operative who wishes to make advancement; (3) the student of more advanced education in general lines who wishes to make textile work a life occupation, and who seeks to fit himself for an executive position. To the first class the schools of the state have offered practically nothing. The reason is that the schools have not hitherto obtained the co-operation of the mills. Either the school must build a mill to meet this need, or the mill must offer instruction in the part of the work that the school cannot give, the latter plan being the better at least in Massachusetts. For the man who is looking for something better than the routine life of the operative, the textile school is already doing much. The evening schools provide good opportunity for him. There is much being done also for the student who can give his whole time to acquiring knowledge of textile manufacturing, but here again closer co-operation is needed between the school and the mill. A great advance in the textile industry would be made if the mills would undertake to send promising men to the schools for education, continuing to give them practical training in the mill. — G. E. Partridge.

The Workers' University of the International Ladies' Garment Workers Union. *L. S. Friedland.* School and Society, March 20, 1920, 11, No. 273, 348–350. — Both in principle and in method, adult and trade-union education is still in its infancy. Even in England and Denmark this is still the case. Labor education is not essentially a training for vocation; rather it is a means of developing avocations. The basis of all education of adults is the relation of the individual to the various groups to which he belongs. Industrial education must include a knowledge of the

whole sweep of one's occupation. There must be more attention in this education to the human element. The right use of leisure must be taught. The educational activity of the I. G. W. U. began in 1914 on these lines and it now includes a large number of schools in which general cultural subjects have a large part. — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

MENTAL

The Modern Specialist in Unrest. Place of the Psychiatrist in Industry. *E. E. Southard.* Indust. Management, June, 1920, 59, No. 6, 462–466. — This is the third of a series of articles on "Mental Hygiene in Industry," which the late Dr. Southard has contributed to *Industrial Management.* In dealing with many of the problems of human relations in industry it is pointed out that the psychiatrist can render able assistance to the employment manager. Turnover, for instance, is often a problem of mental rather than physical adjustment. Such causes for leaving as the following may often suggest to the psychiatrist a line of profitable investigation:

Did not like supervision
Refused to be transferred
Resented criticisms
Did not like working conditions
Work too hard
Agitator
Carelessness
Dishonesty
Drinking
Fighting
Indifference
Insubordination
Too slow

The psychiatrist must deal specifically with individuals rather than with groups. Already he has had to do with that type of unrest which is confined within asylums. His field may well be enlarged to include the less obvious but much more disconcerting types of mental unrest which are to be found in every walk of life. — C. H. Paull.

CENTRAL NERVOUS SYSTEM

Neuroses Following Trauma, and Medical Testimony. *Th. Rumpf.* Deutsch. med. Wchnschr., May 6, 1920, 46, No. 19, 507. — The strictly traumatic neuroses must be differentiated, on the one hand, from diseases with an organic basis, such as concussion, epilepsy, tetanus, myasthenia, hyperthyroidism, which are recognized by their objective manifestations, and, on the other hand, from the functional neuroses, neurasthenia and hysteria. The boundary line between neurasthenia and hysteria cannot be very sharply drawn. The classical picture of "nervous exhaustion" arises rather rarely as the result of a single accident; usually it is produced by a long-continued strain or series of small accidents, in a previously healthy individual. Hysteria is a sort of catch-all classification for cases in which we find an inconsistently abnormal physical or psychical reaction. It is considered never to be an acute disease, but to be either congenital or gradually developed in the course of a lifetime.

The true traumatic neurosis or fear neurosis (Schreckneurose) is characterized by the fact that it develops as the physical injury heals. It is doubtless emotional in origin, and its manifestations often resemble those commonly produced by emotion: flushing, faintness, and nausea. The well-known vasomotor symptom-complex is an excellent example. The symptoms are often similar to those of hysteria, from which they may be distinguished by the fact of their acute origin and their improvement under appropriate treatment, although of course it must be remembered that a traumatic neurosis may develop in a neurasthenic or hysteric. On the other hand, organic injuries especially those of the head may simulate fear neuroses; but the former tend to disappear under appropriate surgical treatment, while the latter tend to be aggravated. Of course, mixed forms of all these conditions occur, but it is important to differentiate them as far as possible.

All of the post-traumatic neuroses were formerly considered practically incurable, and they are so as long as the patient remains out of work and on a pension. His mind comes to dwell on his symptoms and to magnify them, and it becomes his sole aim to obtain protracted

compensation. The aid and advice of a lawyer often makes his condition so much the worse. Consciously or unconsciously such patients often become malingerers in addition.

The only practical treatment of such cases is final settlement of the claim by a lump sum as soon as possible after the accident. In the author's series, 70 per cent. of cases were thus cured in a short time, and 16 per cent. improved. The earlier the settlement is made, the less nervous is the patient's temperament, and the younger he is, the better is the prognosis. Hypnotism has been used by Nonne, but has not been successful in other hands.

The compensation due to patients, the victims of traumatic neuroses, is better decided by an experienced physician or board of physicians, than by the lengthy processes of a court of law. The attending physician must attempt to estimate the extent of physical and psychic damage, any attempt at malingering, and the amount and duration of disability. An excellent means of deciding any disputes which may arise is a board of impartial physicians, presided over by a lawyer, before which the plaintiff's and the defendant's doctors may plead as attorneys. — T. J. Putnam.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Corrected Eyesight. *Hal Brown.* Factory, July 1, 1920, 25, No. 1, 55–56. — The writer calls attention to the fact that frequently minor eye defects are more serious than severe and quite obvious defects. In the case of the latter, eye muscles will not attempt to obviate difficulties of vision, while in the former, because of the possibility of increasing the power of vision by strain, the muscles will make the added effort.

In the plant of the Whiting and Davis Company, where there is a large amount of fine work on various forms of jewelry, all employees' eyes were tested with the following result:

Glasses were ordered for	83.3 %
Glasses used were satisfactory for .	8.3 %
No glasses were needed for	8.4 %

After employees had been satisfactorily provided with glasses, an increase in production was noted. This increase amounted to 28.03 per cent. when two months were compared. — C. H. Paull.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Quarry Accidents in the United States during the Calendar Year 1918. *Albert H. Fay.* U. S. Bur. Mines, Tech. Paper 245, April, 1920, pp. 51. — This report contains tables presenting information on accidents (1) in all quarries; (2) in classified quarries, i. e., cement rock, granite, limestone, marble, sandstone and bluestone, slate, and trap-rock; and (3) according to principal causes. — M. C. Shorley.

Industrial Explosion Hazards: Gases, Vapors, Flammable Liquids, and Dusts. National Safety Council, Safe Practices, No. 34, pp. 12. — The first part of this pamphlet is devoted to a discussion of gases, vapors, and flammable liquids; the second part deals with dusts and the part played by building design, ventilation and plant cleanliness in the prevention of dust explosions. — M. C. Shorley.

Conveyors. National Safety Council, Safe Practices, No. 35, pp. 12. — This pamphlet points out hazards met with in the operation of conveying equipment and cites methods whereby these hazards may be avoided. — M. C. Shorley.

Analyzing Accidents to Reduce Them. *H. W. Patton.* Factory, Aug. 1, 1920, 25, No. 3, 370–371. — The Burroughs Adding Machine Company has developed a plan of accident publicity by which they present to their employees some of the major characteristics of accidents occurring in their plant. Statistics are presented in three charts. By a simple line chart they show the frequency of accidents for the days of the week for both day and night workers. A second chart is in the form of a dial which shows the frequency of accidents by hours for the day and night. The third chart by means of lines drawn from a human figure shows the frequency of accidents as related to parts of the body. These charts were used in a recent safety exhibit and

appeared at about the same time in the company paper.

Where a high rate of frequency was indicated an attempt was made to explain to the employees the cause. The fairly high rate of accidents on Mondays was accredited to the fact that employees did not settle down to work promptly enough after their Saturday afternoon and Sunday holidays. The frequency of accidents during the latter part of the morning was explained as due to employees becoming hungry and somewhat tired as noon approached. Employees were warned to be on their guard at these times. Other accident tendencies are explained in a similar manner. — C. H. Paull.

The Medical Examiner versus the Coroner. *Charles Norris.* Nat. Munic. Rev., Aug., 1920, 9, No. 8, 498–504. — Dr. Norris discusses in this article the advantages of substituting the medical examiner for the coroner. Speaking from his experience as medical examiner of New York City, he outlines the qualifications and duties involved in such an office. "One of the most serious tasks that the medical examiner performs is the determination of criminal negligence in accident cases." The medical examiner must be familiar with industry to the extent of being able to determine accurately the significance of chemical and mechanical agents in bringing about death. — C. H. Paull.

INDUSTRIAL SURGERY

Plastic Operations upon the Thumb, and Finger Transplantation. *P. Manesse.* Deutsch. med. Wchnschr., March 25, 1920, 46, No. 13, 352. — The author briefly reviews the literature of "anticheiroplastic" operations, and reports in detail, with illustrations and a diagram, a case in which a thumb was manufactured and a finger transplanted. The patient had lost the distal phalanx of the thumb, the entire first two fingers, and had a stiff, useless ring finger. A strip of iliac crest was implanted into the abdominal wall, and a pedicled graft was made of it, to which the stump of the thumb was sutured, the proximal phalanx being nailed to the bony transplant. In five weeks, the pedicle was severed, and a thumb was modelled out of the tissues with excellent cosmetic and functional results. As the fibrous ring finger was useless for apposition, it was removed by resecting the distal third of its metacarpal, with as little injury to the soft parts as possible, and implanted upon the metacarpal of the middle finger. No attempt at tendon transplantation was made, but some movement was obtained by means of the intrinsic muscles of the palm, and the usefulness of the hand was greatly improved. — T. J. Putnam.

Critic of Theories regarding Death from Burns. *Hermann Pfeiffer.* Wien. klin. Wchnschr., Dec. 11, 1919, 32, No. 50, 1195. — In fatal burns there is a short period in which occur reflex disturbances radiating from bulbar centers. These are quickly followed by the general reaction in which there is evidence of blood and vascular damage — hemoglobinemia, plasma loss, etc. Following this, there is an outpouring into the circulation of a peptolytic ferment which is excreted in part by the kidneys. During this stage there is also a lipoid mobilization in the body, and a rise in the protein metabolism. These all result in a leucopenia, lowered blood pressure, lowered body temperature, damage to the adrenals, and then death. In recoveries, the excretion of the ferment is continued by way of the kidneys, and there is a leucocytosis, fever and increase of fibrin in the blood. — Barnett Cohen.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

The Normal Existence of Zinc in the Human Organism. *C. Ghigliotto.* Abstracted from Ann. fals., 1919, 12, 12–14; Expt. Sta. Rec., 41, 465, by E. H. in Chem. Abstr., May 10, 1920, 14, No. 9, 1373. — "G. reviews conflicting statements in the literature as regards the presence of Zn in the human body, and reports the results of the examination of the viscera of 22 victims of accidental death. The content of ZnO found varied from 0.0015 to 0.0028

per cent. of the viscera. Zn was also found in a human and a bovine fetus. This is thought to be an indication that Zn is a normal constituent not only of the human organism but of the animal organism in general." — W. O. Fenn.

Time and Job Analysis in Management. V. — How to Work Up and Use Time Studies. *William O. Lichtner.* Ind. Management, Aug., 1920, 60, No. 2, 130–139. — A number of paragraphs of this article are devoted to the discussion of the relation of time studies to health and fatigue. Although rest periods have been introduced with considerable success in certain lines of work, the writer feels that the whole question of rest periods is complicated by the individual physical differences of employees. An ideal fatigue study should be made by the research man, the plant doctor, and the nurse, working together. The research man will be most concerned with production records. The doctor with the assistance of the nurse will determine physical conditions which parallel variations in production. At the same time a careful check will be kept upon the activities of individuals under observation to be sure that factors not connected with their work in the shop do not affect their physical condition and thereby their production records.

In the meantime much can be done to prevent fatigue by (1) selecting employees who are physically adapted to their work, (2) training employees in the most efficient and least fatiguing methods of doing their work, (3) providing as far as possible mechanical equipment for keeping fatigue at a minimum.—C. H. Paull.

Individual Differences in Output in the Cotton Industry. *S. Wyatt.* Industrial Fatigue Research Board, Report No. 7. Textile Series No. 1. His Majesty's Stationery Office, London, 1920, pp. 13. — This report points out that in some operations, such as spinning, the output is controlled almost entirely by the machine, while "drawing-in" (by hand) is entirely dependent on the skill and speed of the worker. Between these two extremes the individual and mechanical factors seem to be combined in different proportions, and one of the aims of the investigation was to determine the extent of individual differences in output in various departments of the cotton trade. The results given are based almost entirely on the figures given in the books of the various mills, the chief source of information being the weekly wage lists. Output depends on many different factors. Although adjustments of the standard piece rates are exceedingly accurate and are supposed to eliminate the variables, these have, nevertheless, been avoided wherever possible and only the figures used for comparative purposes which have been obtained under approximately similar conditions of work. Processes have been chosen which yielded reliable figures over an extended period and in order to reduce the results obtained to a comparable basis, the average, whether in hanks, weight, or money, has been converted to 100 and all other quantities modified in the same proportion. The results given show the mean variation between the actual wages earned and the average wage, which, having eliminated all doubtful factors, the investigators give as an index of variability of individuals. Tables are given for various processes — plain and fancy weaving, mule and ring spinning, etc.

The conclusion arrived at is that spinning shows the least difference between individuals, while weaving and winding give rise to large individual variations in output. Thus the human element in weaving and winding is of great importance, and suggests that it is in these processes, rather than in spinning, that efficiency may be increased and fatigue reduced by the elimination of waste in method and movement. — W. E. C.

Studies in Industrial Physiology: Fatigue in Relation to Working Capacity. 1. Comparison of an Eight-Hour Plant and a Ten-Hour Plant. *Josephine Goldmark* and *Mary D. Hopkins.* U. S. Pub. Health Ser., Pub. Health Bull. No. 106, February, 1920, pp. 213. — This report is the first of a series to be published by the Public Health Service dealing with the problems of industrial working capacity. It represents essentially the application of methods of output and accident quantitation to the study of two large factories, one of them being obviously the Ford Motor Company in Detroit and the other a less easily identified eastern establishment. The first of these plants, as is well known, operates upon an eight-hour basis, the second is represented as comparable in the general character of the metal-working operations carried on, but employs a ten-hour day.

The report is long and presents data gathered in the field by thirty-three individuals. Before making any analysis of the material presented it may be said that three considerations will become prominent in the mind of the careful reader. (1) Can a comparison of two factories under different management give any valid information as to the proper length of the working day ? (2) Do output and accident incidence data justify conclusions relative to fatigue ? (3) Is it sound procedure to neglect practically entirely the medical and sociological aspects of a problem so important and so pretentiously undertaken as the one in hand ? We shall have a more satisfactory basis for the discussion of these points after reviewing the conclusions presented and certain facts relative to the collection of the data upon which they are based.

Summary of Conclusions

I. Relative Efficiency of the Eight-Hour and the Ten-Hour Systems as in Operation at the Two Plants Studied

"A comparison of the 8-hour and 10-hour systems leads to the conclusion that the 8-hour system is the more efficient. This is evidenced by —

"1. *Maintenance of output.* — The day shift: The outstanding feature of the 8-hour system is steady maintenance of output. The outstanding feature of the 10-hour system is the decline of output.

"2. *Lost time.* — Under the 8-hour system work with almost full power begins and ends approximately on schedule, and lost time is reduced to a minimum. Under the 10-hour system work ceases regularly before the end of the spell and lost time is frequent.

"3. *Stereotyped or restricted output.* — Under the 10-hour system artificial limitation of output is widely prevalent. Under the 8-hour system output varies more nearly according to individual capacity.

"4. *Industrial accidents.* — (a) In the absence of fatigue, accidents vary directly with speed of production owing to increased exposure to risk.

"(b) The breaking up of this regular variation by fatigue is indicated by —

"(1) The rise of accidents with the fall of output;

"(2) The disproportionate rise of accidents with the rise of output and the absence of a proportionate fall of accidents with the fall of output in the final hours of the day.

"(c) The importance of fatigue in the causation of accidents is emphasized by the fact that the higher accident risk accompanies the deeper decline of working capacity —

"(1) In the second spell as compared with the first;

"(2) In muscular work as compared with dexterous and machine work;

"(3) At the 10-hour plant as compared with the 8-hour plant.

"(d) The level of the accident rate varies inversely with the experience of the workers.

II. General Data

"1. *The night shift.* — Under the 10-hour system a 12-hour night shift is the rule. The chief characteristics of the 12-hour night shift are the abrupt fall of output in the last two hours and the progressive slowing in rate of production during the night.

"2. *Labor turnover.* — (a) Labor turnover is directly associated with distasteful working conditions, such as long hours, low wages, and undesirable physical surroundings. It is lowered by systematic effort to improve conditions and fit the workers to their jobs.

"(b) Turnover is highest among new employees.

"3. *The effects of rest.* — (a) Recesses.

"(1) *Effect on total daily production.* — Varying results follow the introduction of 10-minute recesses in the middle of the morning and afternoon spells. With some workers the loss of time is not made good and output falls; with others the acceleration due to the recess exactly balances the loss of time and output remains the same. In 12 out of 16 operations studied there was an average increase of production after the introduction of recesses. In operations having two periods of trial the gain in the second period was, on the average, five times greater than in the first.

"(2) *Effect on hourly rate of production.* — Recesses usually lead to a rise in the rate of production in the hours immediately following as compared with the hours immediately preceding the recess.

"(b) Holidays. — Holidays cause an increase in output.

"4. *Rhythm in industry.* — In certain machine operations, notably in lathe work, output is maintained at an even level, instead of falling in the final hours of work. This pe-

culiarity may in large part be explained by the phenomenon of rhythm to which lathe work is highly amenable."

DISCUSSION

1. *Maintenance of output.* — Clearly studies of average as absolute output in the ordinary sense could not form a useful or possible basis for comparison of the efficiency of eight and ten-hour working systems. As a consequence the observers have operated upon a different plan. They have regarded as comparable the deviation of each plant from its own best standard; that is, the relative fall from maximum of each hour at each plant. Thus, instead of expressing the average output per hour as variations from the average hour in the working day, they have expressed them as variations from the *best* hour, as shown by the hour of maximum output. "For our preeminent interest is not in the worker's approximation to his average performance but in his approximation to his best. It is accordingly the maximum hour which we have made our standard of comparison, rating each other hour by its fall from the hour of highest efficiency."

The report, therefore, compares the deviation of each plant from its own best standard — that is, the relative fall from maximum of each hour at each plant — and under this method of comparison it is found that in the 8-hour plant output remains nearer to the production of its own best hour than in the case of the 10-hour plant.

The operations studied were classified under four main heads: dexterous handwork; muscular handwork; machine work on lathes; and miscellaneous machine work. In the 10-hour factory the product was largely brass fuses for 3-inch shells, and in the 8-hour factory standardized parts of an automobile, and effort was made to compare processes which under the above general headings could be regarded as analogous.

A series of twenty-three curves with accompanying tables show rather strikingly the better adherence to maximum effort in the 8-hour factory. One cannot question the fact of this observation. One is, however, sceptical as to whether the major reason for this difference lies in eight hours' work in the one instance and ten hours' in the other. The curves under discussion are of various types, their shape depending to a certain extent upon the character of the task with which they are concerned. "The main features common to all these curves are the rise of output from the level of the first hour of work toward maximum and the fall of output at the end of each working spell and the end of each shift." The rise in the curve is attributed to practice and the fall to fatigue. The curves display these features together with certain differences between light and heavy work already known through the reports of the English Committee upon the Health of Munition Workers. The great deviations from maximum efficiency noticed in the curves of the 10-hour plant are found in the first and last hours of the working day. There is, furthermore, an average tendency toward a lower level of efficiency in the second spell in the 10-hour as contrasted with the 8-hour establishment.

2. *Lost time.* — Figures are presented both in terms of power consumption and direct observation of operatives which show that in the 8-hour plant work with full power begins and ends approximately on schedule, and lost time throughout the day is reduced to a minimum. At the 10-hour plant work ceases regularly before the end of the spell and lost time throughout the day is frequent. These differences are not ascribed by the observers to differences in the excellence of management in the two plants; "they point to a universal tendency. The 'tradition of slowed labor' to which the British Health of Munition Workers Committee ascribes the 'conscious or unconscious slackening of effort . . . during working hours of improper length' is accountable in large part for lost time as well as stereotyping."

3. *Stereotyped or restricted output.* — The practice of voluntary fixation of output is declared to have been very frequent in the 10-hour plant. In fact, the statement is made that "So widespread, indeed, is its influence that operations at the factory should perhaps be classed as more or less stereotyped rather than as stereotyped and non-stereotyped." Such a frank announcement must unfailingly arouse distrust in the mind of the reader in regard to the direct relation between falling output and fatigue, which is the great contention of the report in regard to the 10-hour plant. It is, however, followed by the statement that "Care was taken in the investigation not to include in the general studies of output those processes in which production was to any marked degree thus limited."

The report presents as possible causes for the

stereotyping so prevalent in the 10-hour plant the fear of the workers that on increasing their output the piece rate will be reduced and the possibility that organization of labor may be of importance, but both of these are dismissed as being worthy of no serious consideration. It is held that, "The fundamental cause for limitation of output, however, lies deeper. No group of workers could continue, without physical disaster, to work at full capacity for a stretch of 12 hours at night or 10 hours in the daytime, not to mention the 3 hours overtime irregularly worked at the 10-hour plant. Low speed, wasted time, limited output are in large part the worker's automatic defense against exhaustion, against the overstrain of excessive hours of labor.

"On this point the British Health of Munition Workers Committee has acutely said: 'In so far as hours of work in excess of those suitable for maximal efficiency have been imposed during the last two or three generations of modern industry upon the workers, a tradition of slowed labor must necessarily have arisen, probably in large part automatically, as a kind of physiological self-protection. Without some conscious or unconscious slackening of effort indeed during working hours of improper length in the past, the output might have been even more unfavorable than it is known to have been for the hours of work consumed.'

"For this 'tradition of slowed labor,' for the stereotyping which has been illustrated at the 10-hour plant, the cure is, above all, the reduction of hours of labor."

4. *Industrial accidents.* — This section opens with a useful summary of previous accident incidence studies which in the main maintain that accidents are related rather to speed of production than to fatigue. The authors have presented material in the first section of their report which shows a significant failure to maintain output in the 10-hour plant as contrasted with the 8-hour, and they have related this fall in output to fatigue. They now propose to show that absolute figures giving the hourly accident incidence throughout the day are valuable only in relation to the figures of output and the number of workers engaged. If it can be shown that, as the working day progresses and fatigue begins to develop, the chance for injury to each worker increases, then we shall have a positive correlation between accident incidence and fatigue such as does not exist at the present time. The investigators have taken every precaution to see that the listing of accidents, their exact time of occurrence, their relation to previous hours of work, and the total number of individuals engaged hour by hour are accurately known, and these data are correlated with carefully gathered figures for hourly output.

"At the 8-hour plant the investigation of the Public Health Service covered all accidents occurring throughout the factory during the three months of September, October, and November, 1917, a total of 13,205. The working force during this time averaged 36,000 and was practically stationary. At the 10-hour plant a study was made of the accident records for two years, 1916 and 1917. For these years the accidents numbered 17,516 and 15,728, respectively, a total of 33,244. This was a time of rising employment due to war orders, the working force mounting, between March, 1915, and December, 1915, from 4,720 to 8,200, in 1916 averaging roughly 11,000, and in 1917, 12,000. The entire study, then, covered roughly 46,000 accidents and 50,000 workers."

In the studies of output the use of the "best hour" gave a basis for comparison of the two factories and now, in the case of accidents, a somewhat similar and new basis is used. "In the study of accidents . . . the best hour is that of the minimum accident risk. This minimum should obviously be the standard of comparison, and the important consideration is how far and for what reasons the accident hazard of other hours rises above it. It is evident from what has preceded that it will not do to take simply the hour of fewest accidents as the minimum; our standard of comparison must be the hour of lowest risk per unit of output, the lowest point of the ratio."

Charts and tables are presented which induce the following conclusions:

1. APPROXIMATION OF THE CURVES OF ACCIDENTS AND OUTPUT: SPEED OF PRODUCTION

"In the absence of fatigue, accidents vary in the main with speed of production. They may vary at the same rate with speed, when the curves will be parallel, or at a more rapid rate when the curve of accidents will be of the same general form as that of output, but steeper. This variation is roughly illustrated in certain types of work by the rise of accidents with rising output in the earlier hours of the day.

During these hours the increase of injuries is to a considerable extent automatically determined by the added number of motions with the attendant exposure to danger, or by the generally increased risk inherent in more highly speeded machinery. Similarly, with lowered speed, the automatic reduction of motions and attendant danger will lower accidents at the end of each spell and preserve the correspondence of the curves. Exact variation of accidents with output, though at a more rapid rate, is most closely approximated in both spells at the 8-hour plant, where fatigue is only slightly indicated, and at the 10-hour plant in the first four hours of machine work, the type of activity showing least evidence of fatigue. In both cases the variation of accidents with output is roughly as 4 to 1, or in other words, accidents vary four times as fast as output."

2. DIVERGENCE OF THE CURVES OF ACCIDENTS AND OUTPUT: FATIGUE

"(a) *Disproportionate rise.* — That the variation of accidents with the increase or decrease of output is not a mere mechanical result of varying speed is shown by the fact that the rate of variation is not constant. Both in dexterous work and to a less degree in machine work at the 10-hour plant the rise of accidents is disproportionate to the rise of output. Other factors besides speed of production must account for this increase. Among these, loss of coördination, the readjustment of rhythm to changing speeds, may play some part. Prominent among these factors appears to be fatigue, to which the accident curve, it has been suggested, responds more sensitively and more quickly than the curve of output. According to this hypothesis, fatigue is registered first not in a lessened quantity of work but in impaired quality, in errors and growing inaccuracy. [There is excellent physiological basis for this contention not only in the work of Franz and Woodworth which is quoted, but also in the work of Ash.] In chapter 2 we have traced the decline of working capacity in regard to quantity of output only. Our present data tend to show that, even while output is still rising, the onset of fatigue may be indicated by a disproportionately great increase of accidents.

"(b) *Striking disparity of the curves of accidents and output.* — In all hours of falling output except the final hours of the spells accidents continue to rise with the fall of output. Even at the 8-hour plant, where, as we have seen, the variation of accidents with output is in most hours approximately exact, a fractional decline of output from the sixth to the seventh hour is accompanied by a six-point rise of accidents. In this striking disparity the influence of fatigue in the causation of accidents is seen in conspicuous contrast to that of speed of production.

"(c) *Disproportionate fall of the curves of accidents and output.* — In the final hours of the day accidents fall with the deeper fall of output. In the absence of fatigue, this decline of accidents should be, as we have seen, proportionate to the decline of output, owing to lessened exposure. But the counterinfluence of fatigue breaks up this correspondence. By tending to increase accidents it checks their automatic decline. So much greater, therefore, is the fall of output than the fall of accidents that accident risk still ascends."

These very interesting conclusions are then followed by paragraphs discussing accident incidence in the 10-hour plant in machine work, dexterous work, and muscular work, and the contention that fatigue to a certain degree is responsible for accident incidence is well maintained. One, however, misses a similar group of studies from the 8-hour plant. Inasmuch as we have been led to believe that fatigue is a far less prominent feature of work in this plant it is regrettable that the more exact analysis presented by unit types of work is not given for the 8-hour establishment. It is also regrettable that no data upon accidents for the days of the week are given, since, if fatigue plays the part in accident causation which the report strives to indicate, there should be a cumulative effect up to the period of Sunday rest.

A very interesting section of the report portrays the relation between accident incidence and inexperience. It is shown that from the point of view of safety beginners are undesirable employees. It is, however, held that in studies concerned with the distribution of accidents and the hourly risk, inexperience is unimportant, merely tending to raise the level but not to alter the character of the total accident curve. While this is true we must not neglect the fact that unfamiliarity with any type of neuromuscular activity operates very readily for the production of fatigue, and it is unfair to compare a stable and older group of employees, such as the 8-hour factory possessed,

with a less stable group such as were found in the 10-hour plant. Such an objection is adroitly but not convincingly dispelled by the contention of the report that the 10-hour day is the chief cause of all the evils which the report lists. Reduce to eight hours of work, and the labor instability, lost time, stereotyping, accident incidence, and fatigue would all be cared for simultaneously.

Of the general data presented, that dealing with (1) *The night shift* and (2) *Labor turnover* offers nothing that is unexpected or novel. The next section, however, dealing with *The effects of rest* is worthy of note in view of the large interest in "rest periods" which now exists. The questions to be answered are: "Does the interruption of work lead to a fall of output? Does it enable output to be maintained? Does it do more?"

"In the Public Health Service investigation an attempt was made to obtain exact information on these points, to learn and record the actual effects of a 10-minute break in the morning and afternoon. The inquiry was a difficult one, complicated by the prejudices of both foreman and workers. Fear of losing time and wages, the common dislike of innovations, had to be overcome. In one department the antagonism to the experiment was so great that it had to be abandoned, although two weeks of trial were successful and promised further gains. Moreover, much difficulty was found in keeping under observation for a sufficient length of time the performances of the same persons before and after the introduction of recesses."

"In all, recess periods were introduced in 12 different operations of the 10-hour plant. In 11 of these the average daily output per worker increased after the recesses were put into effect. That the improvement was continuous and showed cumulative benefits is proved by the fact that in the four operations which had two periods of trial the gain in the second period was, on the average, five times greater than in the first; the increase in output, which averaged about 2 per cent. in the first period, averaged over 11 per cent. in the second."

In the 8-hour plant recesses were introduced in several departments but with almost uniform lack of success as regards increasing total output. Differences in the character of stock and a tendency to spurt immediately following the recess are given as partial reasons for the failure of the rest periods in this factory.

Finally, the report shows that after holidays total output rises but that this increase is not observed until a perceptible lag of a day or so has passed.

The last chapter of the report gives preliminary details of rhythm in industry. It represents the single novel feature of the entire work of the Public Health Service investigators and its further details will be awaited with interest by readers in this field.

Attention is first called to the fact that in certain operations — of which lathe work presents a typical example — output remains very constant throughout the working day. There is none of the drop in output curves which is held to portray fatigue. "To establish the presence of rhythm and to compare its degree in different operations, the investigators have used an automatic rhythmometer, which records the worker's motions by electrical contacts on a kymograph, or recording drum." A series of such records are published and display a surprising degree of regularity in the various movements required to complete a typical lathe operation. It is brought out that the inexperienced and slower worker is less rhythmical than the old hand, and the inference is allowable that not only does rhythm mask fatigue in studies of output statistics but it also possibly actually wards off fatigue. The nearer neuromuscular processes approach an automatic basis the less taxing they appear to be.

This rather extended summary will give an impression of the work undertaken by the Public Health Service. Actual reading of the report gives one confidence that the recorded observations have been made with painstaking faithfulness and practically entirely in the field. There is no doubt that much of the data assembled represents a distinct addition to output study, and the reader must feel that for the individual plants in which the work was done real facts have been obtained.

It is, however, very hard to believe that the data permit the rather frank generalizations which the report brings constantly into the mind of the reader. The presentation strikes one more as a well-organized argument for eight hours of work than as a thoroughly dispassionate display of the facts at hand. An opening paragraph of the report is as follows:

"Limitations of the Present Study. It is obvious that complex human conditions do

not admit of the controlled experiments of mechanical and laboratory research, in which variants can be deliberately excluded at will. While the two factories studied are representative of the metal-working industry, and though comparable types of work and operations have been carefully chosen, allowance must yet be made for the inevitable differences existing between any two individual establishments. A brief description of the plants will make this clearer."

Then follows a description in which it is brought out that labor conditions in the 8-hour plant were more stable and better in every way than in the 10-hour plant during the period of study. Later paragraphs relative to "stereotyping" and "restricted output" serve to re-emphasize these facts and cause one to distrust the comparisons which have been made. The report seems to us, therefore, to present interesting and in the main confirmatory data upon output — material re-enforcing the utility of certain methods of study and conclusions which have already been published by English workers. It does not convince us that a 10-hour day *per se* is a less efficient working period than an 8-hour day. Possibly further studies will be available from the 10-hour factory giving the result of shortening hours. When this is done the case will stand upon a firmer basis.

The question as to whether output and accident incidence statistics furnish data justifying conclusions relative to fatigue is one which still lacks anything in the nature of entirely objective physiological backing. Fatigue is undefined as a physiological entity. The word carries with it an implication of muscular and nervous damage but even in the simplest of laboratory preparations this damage is not as yet defined. The question which output statistics can attempt to answer is the extent of self-limitation in any task. It is within our physiological expectations to see any rhythmical task adjusted as to output per hour in accordance with the number of hours to be worked. Such limitation is unquestionably protective and, as Abbé observed years ago, its existence is accurately reflected by the unconscious speeding up which follows a reduction in hours of work. Without the addition of medical and sociological data to show that a 10-hour day induces actual physical and mental harm which are eliminated by an 8-hour day, we are not ready to admit that self-limitation of work justifies a conclusion that the individual is fatigued.

It is unfortunate that the Public Health Service investigators worked practically entirely with the methods of the English Health of Munition Workers Committee and that the United States is thus unable to contribute to the subject a degree of freshness and originality which its importance demands. Certainly, lacking as we do at the present time any objective method for testing fatigue, it is regrettable that the American investigating committee made no real effort to gather material through a well-organized medical section showing, provided it existed, real nervous or physical damage as a result of a 10-hour day. — C. K. Drinker.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Electrical Equipment in Industrial Plants. National Safety Council, Safe Practices, No. 29, pp. 16. — This pamphlet discusses the dangers of shock, burns, flashed eyes, and mechanical injuries from electrical utilization equipment carrying less than 750 volts, and so located as to be accessible to other than qualified electrical operators. A detailed description is given of proper methods of installing electrical equipment with emphasis placed on their relation to accident prevention. A discussion of methods of rendering first aid in case of supposed death due to electrical shock concludes the pamphlet. — M. C. Shorley.

WOMEN AND CHILDREN IN INDUSTRY

Employment of Women on United States Railroads during 1919. Labour Gaz., May, 1920, 20, No. 5, 581–582. — Statistics are herewith presented which show that the number of women engaged on the Class 1 railroads on January 1, 1919 was 99,737 as compared with only 81,803 on October 1, 1919. — L. A. Shaw.

Children Leaving School for Work. School and Society, July 10, 1920, 12, No. 289, 48–49. — The Children's Bureau of the United States Department of Labor reports that one million children between the ages of 14 and 16 leave school each year in the United States. Only a few children receive any help from their parents in finding suitable work, because parents do not have the necessary information and experience. More than nine-tenths go into "blind-alley" jobs. Many drift, and many find work for which they are mentally or physically unfit. What is needed is more organization in the schools, or in close connection with the schools, since vocational guidance is best conducted in this way. Any scheme for placement and supervision of working children should include provision for further training through compulsory day-time continuation classes. — G. E. Partridge.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Shop Lighting. *K. A. McIntyre.* Pub. Health Jour., June, 1920, No. 6, 266–274. — This is a reprint of a paper read at the Annual Meeting of the Ontario Safety League at Toronto in April, 1920. Estimates of the percentage of industrial accidents attributed to improper illumination range from 23 per cent. upwards. Good lighting stimulates production in the following ways: increased production for same cost; greater accuracy in workmanship with consequent reduction of spoilage; reduced accident hazard; avoidance or at least reduction in eye strain; surroundings made more cheerful; work performed with less fatigue; order, neatness and sanitation promoted; superintendence rendered more effective. All this can be obtained by annual expenditure of less than 1 per cent. of the payroll.

The requirements of natural and artificial lighting are the same: *viz.*, sufficiency under all conditions; diffusion, i.e., the avoidance of glare and of extreme contrasts of light and shadow; maintenance to ensure the conditions contemplated in the proper designs.

Natural Lighting: (1) "Where no overtime operation is in effect 65 to 75 per cent. of the work is done under natural light. (2) Lighting codes require double intensity of natural lighting over artificial lighting because light coming to the eye in daylight from all the surroundings is much brighter than at night; thus a more intense light is required on the work. (3) Light should be adequate for each employee. (4) Windows should be so spaced and located that daylight conditions are fairly uniform over the working area. (5) Intensities of daylight should be such that artificial light will be required only during these portions of the day when it would naturally be considered necessary. (6) Quality of light should avoid glare due to sun's rays or light from the sky shining directly into the eye. Window shades or awnings should be provided where necessary to this end. (7) Ceilings and upper portions of walls should be maintained a light color to increase effectiveness of lighting. (8) Among the special means of improving natural lighting may be mentioned saw-tooth roof construction, skylights and the use of prismatic glass to redirect light into the working space. (9) Wire glass should be used as safeguard where there is danger of glass falling if broken. (10) Some factory laws require the use of clear glass in lower sections of windows to allow employees to exercise long range vision to retain that power. (11) Windows should be cleaned regularly at proper intervals."

Artificial Lighting: (Only electric lighting considered.) Twenty-five to thirty-five per cent. of work is performed under artificial lighting. The first requirement is sufficiency. Intensity will be determined largely by the color and fineness of materials in process of manufacture. The intensities must be sufficient whether working surfaces are in horizontal, oblique or vertical planes. For an average value intensities in a vertical plane will be approximately half those in a horizontal plane of the same installation.

As regards diffusion, various considerations lead to one conclusion — general lighting from overhead. By this it is possible to keep the light source somewhat above the line of vision and to secure uniform distribution by choice of proper reflectors correctly located as to mounting heights and spacing. Drop lamps should only be used when absolutely necessary and then should be covered from view by reflectors.

Three methods of general lighting are avail-

able — direct, semi-direct, and total indirect. The first is the most suitable for factories. This necessitates the use of reflectors, either extensive, intensive, or focusing.

As to maintenance, "according to recent and comprehensive articles the best practical method involves:

"1. The use of a depreciation factor, or factor of safety in the original design of the system to ensure adequate illumination when the system has depreciated a normal amount.

"2. The cleaning of lighting units at frequent, regular intervals.

"3. The replacement of lamps which have become blackened in service by abnormally long life.

"4. The use of lamps at correct voltage rating fcr all replacements.

"5. The refinishing of ceilings and walls at reasonable intervals." — R. M. Hutton.

Exhaust Systems. National Safety Council, Safe Practices. No. 32, pp. 16. — One of the principal dangers encountered by workmen in many industries is the exposure to dust, gases, vapors, and fumes which are generated by various machines and industrial operations. A general classification suggestive of the more common harmful substances met with in modern industry is included in this pamphlet.

The following five methods of removing or rendering harmless dusts and fumes are suggested and discussed: (1) avoid by using wet processes or by installing automatic or closed machinery methods; (2) remove by natural ventilation; (3) remove by mechanical ventilation; (4) render harmless by isolating in a separate room or building the process or machine where the dust or fumes are generated; and (5) render harmless by requiring the operators to wear respirators, helmets, or other protective devices.

Various designs of hoods are described and illustrated, and recommendations are made as to their proper installation. Methods of disposal of dust and fumes gathered through an exhaust system are suggested. — M. C. Shorley.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

What Armco Medical Service Means. *H. H. Smith.* Personnel, May, 1920, 2, No. 5, 8–9. — The Armco Company felt that its duty to its employees should not begin and end with accidents, but that it should do everything within reason to help employees to become better citizens and happier workmen. From the sole care of accident cases, the work has been amplified to include treatment of employees for injuries or ailments beyond those coming under the state compensation law. Herein is described in detail the organization and manner of administering the company's medical and welfare service. — L. A. Shaw.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Housing. Housing Betterment, Feb., 1920. — Contains a useful bibliography of recent books and reports on housing and town planning and several short papers on these subjects. A recent act in England is mentioned, by which powers of the local governments in housing and town planning are increased, and financial assistance from the state, as well as direction and control by the state, are also increased. There is a useful list of economies in construction in England, comprising nineteen items. The housing situation in several countries is described. There is a summary of the town planning movement in Europe; the Garden City developments in France are mentioned; and it is stated that the city of Paris is beginning five new Garden City suburbs for workingmen. The city of Paris has recently voted to demolish its fortifications, and replace them by about 200 hectares of buildings, of which 70 hectares will be model dwellings for workingmen, and will have playgrounds and gardens. The military zone outside the walls will be turned into 450 hectares of parks and playgrounds. New societies have been founded and there are

recent laws, such as a law permitting the pooling and reparceling of property. In Great Britain the chief emphasis in town planning is placed on housing. During the war there has been almost no town planning aside from the housing and Garden Villages designed for munition workers. Since the war there has been launched a great government plan for the building of 500,000 houses. — G. E. Partridge.

HOUSING. Housing Betterment, May, 1920. — Contains a bibliography of about sixty titles dealing with housing and town planning. The situation in England is presented, where the shortage is said to be daily increasing. "On paper England has built 113,681 houses through its Ministry of Health to meet its housing shortage; actually the number of houses that have been constructed (511 to the end of February) is so small as to be negligible. Shortage of labor is the foremost factor in the trouble. Besides news items, there are many brief articles on a variety of phases of the housing problem: plans for financing are described, a new scheme for housing girls in New York — by the community club plan. The announcement of a university course on housing, a study of the present needs and demands, recent laws and enquiries are mentioned. — G. E. Partridge.

YOUR HOUSING PROBLEM — II. HOW SMALL PLANTS HAVE BUILT WORKERS' HOMES. Factory, June 1, 1920, 24, No. 10, 1691–1694. — This article is a review of four housing plans developed on a community basis. The plans are those adopted by the Lockport (N. Y.) Board of Commerce, the Greenfield (Mass.) Chamber of Commerce, the Worcester (Mass.) Housing Corporation, and the Williamsport (Pa.) Improvement Company. Reference is also made to the work of the Pennsylvania State Chamber of Commerce which acts in an advisory and not a financing capacity. In the four community projects finances for building were provided through the organization of housing companies to which manufacturers and other interested citizens subscribed. In Worcester, the banks play an important part in financing building by carrying first mortgages up to 60 per cent. of the cost of construction. In Lockport, five-room houses built by the Lockport Homes Company sold for \$2650 a year ago; six-room houses sold for \$2950. In all cases, except that of Williamsport, houses are sold on reasonable monthly payments. In Williamsport the houses were built in two, four, and six family groups which are much more adapted to renting than to selling. By plans such as those in operation in the four communities under consideration, relatively small companies can share in and contribute toward a housing scheme, much more elaborate than they could undertake individually. — C. H. Paull.

A REAL HOUSING ACCOMPLISHMENT. *H. E. Miles.* Am. Industries, July, 1920, 20, No. 12, 26. — This is a brief statement of the work being done by the Housing and Finance Corporation of Detroit. Stock in this organization is subscribed by manufacturers on the basis of the number of people they employ. Loans are granted for building operations costing from \$3500 to a maximum of \$6000. Supervision of construction is one of the conditions of a loan. — C. H. Paull.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH OF WORKERS — METAL MANUFACTURING INDUSTRIES. Nat. Ind. Conference Board Pub., Research Report No. 18, July, 1919. — This report summarizes the results attained through two questionnaires, the first sent out in the latter part of 1917, the second in March, 1919. "Replies were received from 1,252 establishments employing 753,561 workers. Of these, 413 establishments, employing 358,336 workers had reduced hours, and furnished data as to the effects of such reductions." The geographical distribution of the plants covered by this investigation is fairly representative of the several metal working regions of the United States.

Conclusions as to Output

For a 50-hour and a 48-hour week, in which interest chiefly centers, the evidence presented in the preceding sections is summarized in the accompanying tables.

"Among the more important facts brought out by this comparison and the preceding discussion are the following:

"1. A 50-hour week has proved efficient and

practicable in a large number of metal manufacturing establishments.

"2. A 48-hour week has proved practicable in a considerable number of establishments.

EFFECT ON OUTPUT — 48-HOUR GROUP

Output	1917 Establishments	1917 Per Cent. of Total Employees in Group	1919 Establishments	1919 Per Cent. of Total Employees in Group
Totals	*41*	*100.00*	*40*	*100.00*
Increased	5	67.1[1]	1	9.1
Maintained	13	16.4	5	8.4
Decrease, less than proportional	4	2.9	8	21.2
Decrease, about proportional	10	9.4	14	44.0
Decrease, greater than proportional	1	0.5	3	1.5
Decrease, amount not stated	8	3.7	9	15.8

[1] Over 66% of employees in the 48-hour group were in two establishments.

EFFECT ON OUTPUT — 50-HOUR GROUP

Output	1917 Establishments	1917 Per Cent. of Total Employees in Group	1919 Establishments	1919 Per Cent. of Total Employees in Group
Totals	*66*	*100.00*	*37*	*100.00*
Increased	4	4.9	2	8.5
Maintained	28	47.8	10	12.6
Decrease, less than proportional	12	28.4	9	42.0
Decrease, about proportional	10	9.7	8	11.0
Decrease, greater than proportional	2	3.4	1	1.6
Decrease, amount not stated	10	5.8	7	24.3

"3. The piece-rate system is more conducive to current efficiency of production than is the day-rate system.

"4. There is no clear-cut line below which a reduction in hours brings a practically uniform change in efficiency of production in different establishments."

"Unquestionably, the difference in results under different hours-of-work schedules is attributable in many cases to differences in efficiency of management. On the other hand, it may be that an establishment which failed to maintain production on a 54-hour week may be quite as efficient as one which maintained production on a 50-hour week; the difference in result may be due to differences in the nature of the process, in the character of the raw material, in the type of machinery, or in the type of worker employed.

"Exact mathematical measurement of the effect of changes in hours alone is not possible. Conclusions must necessarily be drawn in a broad way. The value of this study of experience in the metal trades lies in its positive evidence that it is possible not merely for occasional and exceptional establishments but for a considerable proportion of establishments to maintain production on a schedule of 50 hours per week, and that a 48-hour week is a practicable one for a limited proportion of establishments in these industries. Whether such schedules are practicable in individual cases is a problem for the particular establishment to determine. It is obviously to the interest of employers to make a thorough study of conditions in their respective plants in the light of the evidence presented in this report."

Following this section of the report there is a brief discussion of the health of metal workers. The data presented are gathered from U. S. Census Reports, Bulletin 231 of the Bureau of Labor Statistics and somewhat similar sources. There is no actual field study of health conditions and the material presented adds nothing to former knowledge of the subject. — Cecil K. Drinker.

INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS: SPECIAL TESTS IN THE SELECTION OF EMPLOYEES

Civil Service Examination for Psychological Investigator in Employment Tests. School and Society, July 3, 1920, 12, No. 288, 14–15. — The "duties of appointees will be to study and give what are commonly known as psychological and trade tests; to devise and evaluate new tests; to compile statistical reports of results, and to investigate personnel problems." — G. E. Partridge.

A New Method of Rating Teachers. *W. L. Conner.* Jour. Educational Research, May, 1920, 1, No. 5, 338–358. — The author proposes a card for rating teachers according

to the results they obtain from their pupils. Five classes or standards are recognized: inferior, below average, average, above average, and superior. The function of the teacher is analytically expressed in the following terms:

The teacher — personal appearance, character, education, social efficiency;

The government of the school — assignments, morals in the despatch of assignments, freedom to initiate social activities, elimination of antisocial conduct;

Instruction as providing for educative activities, thinking, emotional reaction, acquisition of knowledge and skill, deportment;

The teacher's attention to health and comfort of pupils, play and social life of pupils, grounds, buildings, equipment and supplies, professional ethics.

Using this system as a first method, further study of the factors entering into teaching was made, and the plan of rating modified accordingly. — G. E. Partridge.

A Constant Error in Psychological Ratings. *E. L. Thorndike.* Jour. Applied Psychology, March, 1920, 4, No. 1, 25–29. — Science seems to demand that in all work on ratings for qualities the observer should report the evidence, not a rating, and the rating should be given on the evidence in each quality separately, without knowledge of the evidence concerning any other quality in the same individual. — G. E. Partridge.

What Industry Wants and Does not Want from the Psychologist. *E. Frost.* Jour. Applied Psychology, March, 1920, 4, No. 1, 17–24. — The author enumerates thirty-four types of proposal that have been made for the betterment of industry. This useful list comprises: Americanization of the alien, establishment of bonus systems, better housing of employees, universal continuation schools, increasing efficiency through diet, daylight-saving laws, efficiency engineering in factories, the establishment of foreman's classes, find-yourself campaign for working boys, graded wage scales, compulsory health insurance, industrial democracy systems, special legislative enactments, morale work, diagnostic motion pictures in the shop, nationalization of basic industries, national board of community speakers, psychological tests, questionnaires, personnel ratings, systematic propaganda, recreational athletics, rest periods and fatigue studies, restriction of immigration, shop committees, employment management, socialism, revision of the metric system, excess profits and other taxation, thrift campaigns, unionism, vestibule schools, vocational guidance, and welfare work.

The unrest following the war has emphasized a new set of problems, the main ones being: unionism, labor turnover, selection and training of foremen, education of the alien, wage and hour adjustments, housing, working conditions, and, in some states, health insurance, taxation and continuation schools. Four of these problems have special psychological implications: (1) labor turnover; (2) Americanization; (3) the continuation or part-time school; (4) the problem of the foreman. — G. E. Partridge.

The Present Attitude of Employees to Industrial Psychology. *Susie S. Brierly.* Brit. Jour. Psychology, March, 1920, 10, Nos. 2 and 3, 210–227. — This article, written from the standpoint of social psychology, analyzes the effects upon the attitude of workers resulting from the widespread interest in and introduction of psychological methods into industry. Although it is by no means easy to understand precisely what the attitude of the workers is, on the whole it is one of opposition to the new ideas. On the side of the scientific worker there is much misconception because he has adopted and cherished the abstraction of the economic man as representing the industrial unit. We think too much in terms of wages and hours, and of increased production. Instead we must approach our problem on the broadest human basis.

At the present time the worker is suspicious of the motives actuating the attempt to change industrial practices. He fears also that unemployment will result automatically from scientific industry; and this fear becomes a social and ethical state of mind. He does not believe that the whole labor world can benefit permanently from the innovations. The worker sees in the new movement, too, still further mechanization of work, still further reduction of personality and human dignity in it. The future of individual craftsmanship is questioned. The error consists in the worker's not perceiving that scientific methods do not create the tendency toward specialization, but the objection is deep-seated; men deeply desire to make their daily work a true vocation. To meet the objections of the workers, and to determine the normal and best conditions is a

work that falls especially to psychology as the study of the whole man in all his social relations. — G. E. Partridge.

Employment Psychology in the Rubber Industry. *H. E. Burtt.* Jour. Applied Psychology, March, 1920, 4, No. 1, 1–17. — This is an interesting report of a "consulting psychologist's" work in a Canadian rubber company, mainly in perfecting tests for the use of the employment office. After some preliminary work, vocational ratings were made of a large number of workers in the factory by foremen and inspectors. Of the two current methods in making vocational tests, that of duplicating in miniature so far as possible the work or the mental situation involved, and that of analyzing and testing the mental abilities engaged in the work, the latter was preferred. The tests were given by means of mimeographed blanks to a group of people simultaneously, using thirty-two tests drawn from various sources and covering a wide range. There were also individual tests — adaptations of conventional tests as given in the manuals. Then tests were selected for each operation to be studied, given to workers of all degrees of ability, and each test score correlated with the vocational rating. "The most promising tests were retained, the coefficients corrected for attenuation, partial correlations computed and the regression equation derived in order to weigh the tests and get the best possible prediction for vocational ability. After determining the correlation of combined weighted scores with the criterion, a table was made with deciles of combined weighted test scores tabulated for deciles of probable vocational success. It was thus possible to predict from the test scores the probability of an applicant's being in the highest tenth, next highest tenth, etc., of workers in a given operation. These methods were applied to a number of rather specialized operations — finishing, treading and building tires, handing out stock, and clerical work. . . ." For less specialized factory operations a general intelligence scale was devised. — G. E. Partridge.

Percentiles for Certain Tests of Aptitude. *E. Claparède.* Archives de psychologie, Dec., 1919, 17, No. 68, 313–324. — Percentiles are worked out for tests of memory for words, permutation tests, rapidity of writing and calculation. Results are given for adults and for children. The author thinks the permutation test measures intelligence as shown in inventiveness. — G. E. Partridge.

The Constancy of Individuals with Regard to Tests of Aptitude. *E. Claparède.* Archives de psychologie, Dec., 1919, 17, No. 68, 325–334. — The results show the existence of individual aptitudes having a certain constancy. The correlations are high, but insufficient for the purposes of individual psychology. — G. E. Partridge.

The Applicability of Mental Tests to Persons over Fifty Years of Age. *Josephine C. Foster* and *Grace A. Taylor.* Jour. Applied Psychology, March, 1920, 4, No. 1, 39–58. — From these studies made by the Yerkes-Bridges point scale, the following conclusions are drawn: (1) There are certain definite changes in the distribution of scores on the point scale as the chronological age of the subject increases; (2) these changes are evident in both normal and psychotic persons; (3) there are three probable reasons for the changes — loss of ability, lack of practice, and absence of alertness or of interest; (4) the mental condition of a subject over 50 years of age will be much more accurately presented if two mental ages are given, one which compares him with his own adolescent ability (or with that of normal young persons), and one which compares him with his normal contemporaries. — G. E. Partridge.

Psychological Tests as Diagnostic of Vocational Aptitudes in College Women. *Elsie Murray.* Jour. Applied Psychology, March, 1920, 4, No. 1, 30–38. — The writer tried to extend some routine tests in order to throw light upon practical abilities of students. The tests comprised three series: (1) tests of controlled association, logical memory, completion, proverb matching, generalization, information, etc.; (2) rote memory, rote learning, addition, spelling, cancellation, easy directions and related tests; (3) tests of motor dexterity, alertness to surroundings, etc., such as tapping, card sorting, construction puzzle, weight suggestion, divided attention, etc. . . . A fourth or "social ability" set of tests was added, including a series involving judgments upon personal attributes, situations, and facial expression of the emotions. Thus general intelli-

gence (or teaching ability), accuracy (or clerical ability), practical ability, and social ability were measured roughly at least. There is decided dissimilarity in the four functions measured. Comparison of the student's own vocational choice with the various test scores reveals a fairly high degree of correlation between individual ambition and experimental findings. The article contains a bibliography of thirty-five titles. — G. E. Partridge.

Test Interpretation. *S. D. Porteus.* The Training School Bulletin, June, 1920, 17, No. 4, 68–72. — Reports a study of correlations of gradings of industrial ability, educational attainments and degree of social fitness made by a teacher, with results of the army tests, the Binet tests and the Porteus tests, applied to a group of children. The highest correlation was obtained by the use of the Binet and the Porteus tests together. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Welfare in the Land of the Rising Sun. Am. Industries, Aug., 1920, 21, No. 1, 21–22. — A brief account is given in this article of social and medical work carried on by a large textile company in Japan. Among the facilities offered to employees are:

1. Schooling for men and women
2. Plant papers
3. Dormitories
4. Houses for married workers or a rent subsidy where houses cannot be provided
5. Lunch facilities
6. Clothing at cost
7. Fully equipped hospitals with departments of medicine, surgery, ophthalmology, obstetrics, and dentistry. These facilities are available to workers and to members of their families
8. Extensive recreation facilities. — C. H. Paull.

Welfare Work in a Japanese Electric Plant. *George M. Price.* Mod. Med., March, 1920, 2, No. 3, 235–237. — This descriptive article is based upon the author's correspondence and also upon remarks made by members of the recent International Labor Conference. *The Modern Factory*, by G. M. Price, has been translated into Japanese. Certain large companies have instituted welfare features, recreation, recuperation and housing, and the education of children. Photographs showing some of the sanitary and protective measures in use at the plant of the Tokyo Electric Light Co. are reproduced. These pictures show a fire drill in progress, the plant fire brigade, parts of the plant hospital, a ventilation system, and a lathe worker using a dust respirator, all of which indicate that an excellent beginning is being made in Japan in industrial hygiene and welfare work. — L. Greenburg.

Restaurant Facilities for Shipyard Workers. *Frederick S. Crum.* Mod. Med., Feb., 1920, 2, No. 2, 138–141. — The value of restaurant facilities for industrial workers is emphasized. A brief description is given of the equipment necessary for the establishment of industrial restaurants and of the requirements which must be met in order that the restaurant project be a success. In the discussion of these requirements, convenience of location, attractiveness, prompt service, hours, food, prices, payment, and management are considered. — L. Greenburg.

Vacation Arrangements that Don't Upset Things. Factory, May 15, 1920, 24, No. 9, 1550–1552. — This brief article should be of particular interest because of the novelty of one of the plans which it presents and because of the bearing of this plan upon the health of an entire working force. During the summer the Autocall Company closes its entire plant for a vacation period. With the exception of the general manager and a stenographer, everyone is on a vacation. Preparation for the closing of the plant is begun as far ahead of time as possible. Surplus production is secured where possible and feasible. During the vacation only urgent correspondence is attended to in the office. In the case of all other correspondence a printed form is sent to the writer explaining why his letter is not being answered, and stating the time when the office force will return to its duties. — C. H. Paull.

Workers' Benefit Plan Recently Adopted by the Curtis Publishing Company. Personnel, Sept., 1920, 2, No. 9, 2–3. — The most important regulations of the new Employees' Benefit plan recently adopted by the Curtis Publishing Company are herein given. — M. C. Shorley

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

National Labor Legislation. Bull. International Labour Office, 1918, 13, Nos. 1–10, printed Oct., 1919. — These bulletins contain summaries of recent national labor legislation in Germany, German Austria, Bulgaria, Spain, France, Norway, Russia, and other European countries. In regard to Germany, several interesting items are given, such as orders concerning provision for the unemployed, concerning the extension of compulsory insurance and the right to insurance under the sickness insurance system, orders regulating the hours of work in baking and confectionery establishments and providing for an eight-hour day for industrial workers, and orders regulating the conditions of work and wages in home work, and of child labor, with special reference to boys and girls under fourteen years of age. In Bulgaria there are new regulations concerning the health and safety of workers, and governing the admission of children to industrial and commercial work. In Spain an act has been passed requiring an uninterrupted rest period of twelve hours every day in all commercial work. From France there is a long list of decrees applying to liability for industrial accidents and for protection against alcoholism, and an act to organize the Saturday half-holiday for women in the clothing trades, etc. Norway reports an act making detailed provisions respecting industrial work. From Russia there is a report of a decree of the Central Executive Committee of the Soldiers' and Workers' Representatives concerning the eight-hour working day and the distribution of working hours. — G. E. Partridge.

Abstracts of Committee Reports, Annual Convention of National Association of Manufacturers. Am. Industries, June, 1920, 20, No. 11, 16–17. — Among the reports is one on workmen's compensation laws. The following are given as essential requirements for the efficient and proper administration of workmen's compensation laws:

1. Absolute financial security to the manufacturer;
2. Reduction of losses to a minimum through prevention of accidents;
3. Reduction of duration of disability through efficient medical services and rehabilitation of the injured employee;
4. Prompt and impartial service in determining the amount and in the payment of benefits prescribed by the Workmen's Compensation Act in the state where operating;
5. Maximum economy of expense;
6. Minimum interference as between employer and employee in the making of payments under the law and in the settlement of claims.

The Committee on Industrial Betterment, Health and Safety declared its opposition to compulsory health insurance. It also recommended that as far as possible housing should be made a community matter rather than be left as a burden wholly on the shoulders of industry. — C. H. Paull.

Lead Poisoning and Compensation. Lancet, May 1, 1920, 198, No. 5044, 970–971. — This is a brief discussion of a decision at the Holt County Court upon a claim for compensation under the Workmen's Compensation Act — a claim demonstrating the difficulties which may arise in cases of alleged lead poisoning. The medical evidence, while in harmony as to the existence of lead ingestion as a toxic factor at one period in the patient's history, differed over its bearing upon the neurasthënia and disordered action of the heart present at the time of trial. — K. R. Drinker.

Comparison of Canadian Workmen's Compensation Laws. *Carl Hookstadt.* U. S. Bur. Labor Statis., Month. Labor Rev., March, 1920, 10, No. 3, 171–180. — With but one exception all of the Provinces of Canada, including the Dominion Government, have enacted workmen's compensation legislation. This article reviews these laws, comparing them with workmen's compensation laws in the United States. — L. A. Shaw.

Workmen's Compensation for Occupational Diseases. Nat. Civic Federation Rev., April, 1920, 5, No. 2, 10. — A bill introduced into the Senate and Assembly providing for compensation for occupational diseases. — G. E. Partridge.

Notices and Claims under Compensation Acts — III. *Chesla C. Sherlock.* Am. Machinist, April 15, 1920, 52, No. 16. 844–846. —

In concluding this series of articles, the author discusses the matter of attorney's and doctor's fees and shows the attitude of most compensation commissions in protecting both employer and employees from exorbitant fees. — G. M. Fair.

Minimum Requirements in Compensation Legislation. *Royal Meeker.* U. S. Bur. Labor Statis., Month. Labor Rev., Nov., 1919, 9, No. 5, 280–293. — A paper read at the sixth annual meeting of the International Association of Industrial Accident Boards and Commissions, held at Toronto, Canada, Sept. 23–26, 1919. The writer discusses his subject under the following headings: *Is Uniformity Desirable and Feasible? The Purposes of a Workmen's Compensation Law; Coverage; Occupational Diseases and Poisons; Insurance; Waiting Period; Medical Benefits; Money Benefits; Administration; Accident Reporting and Statistics.* — R. B. Crain.

The Relative Merits of Different Compensation Insurance Systems. *Carl Hookstadt.* Am. Labor Legis. Rev., March, 1920, 10, No. 1, 15–24. — The writer applies the test of security and service to the several types of workmen's compensation insurance known in this country. These types are: (1) private insurance carriers, either stock or mutual; (2) competitive state funds; (3) exclusive state funds; (4) self-insurance.

In discussing the element of security as it is related to these four types of insurance, it is pointed out that in the case of stock insurance carriers two elements are involved: (1) adequate insurance rates, and (2) adequate reserves. In the case of the mutual carriers the same provisions apply, though from the standpoint of the employee greater protection is furnished, inasmuch as employers insured in mutual companies are subject to assessment when the losses exceed the premiums. There are now in existence eight exclusive state funds and nine competitive state funds. The writer recommends that provisions as to rates and reserves be applied as rigidly to state funds as they are to private companies. Although no state fund as yet has become insolvent, some of them provide payment to claims only while the fund exists. Except in the states where exclusive state funds exist provision is usually made for self-insurance. In some states self-insured employers are required to furnish proof of their solvency or provide security. Although self-insurance seems to have worked satisfactorily, the writer feels that sufficient security is not provided in some cases at the present time. Self-insurance should, in his opinion, be "subject to the same supervision and regulation as to security and reserves as those imposed upon regular insurance carriers."

In discussing the element of service, attention is called to the following principal tests: accident prevention, just compensation awards, promptness of payment, minimum of time and expense in adjudicating contested cases, aid given claimants in obtaining their compensation, medical aid and supervision, and care of permanently disabled.

In connection with the question of just awards, three causes are indicated as leading to non-payment or underpayment of benefits: (1) lack of proper government supervision and administration; (2) ignorance of employees as to their rights; (3) dishonesty on the part of the employer or the insurance carrier. In New York State it was found that in an analysis of 1000 cases selected at random 114 were underpaid. The guilt for this underpayment seems to have fallen particularly at the door of private stock companies and self-insured employers. In order to reduce underpayment to a minimum, certain precautionary steps should be taken: (1) An authoritative commission should be established to administer the compensation act; (2) this commission should receive promptly reports of all compensable accidents; (3) all fatalities and doubtful cases should be investigated; (4) care should be taken to see that injured employees understand their rights under the law, and have an opportunity to present their version of the accident.

In taking up the question of promptness of payment it is pointed out that the worker should begin to receive compensation as soon as possible after the accident. Promptness may be facilitated by a thorough and business-like investigation of claims. In a recent investigation of the relative promptness with which compensation claims are paid under different types of insurance it was found that "the stock companies have the least creditable showing and the state fund the most creditable." — C. H. Paull.

Group Insurance as Employees' Service. *Edward E. Rice.* Indust. Management, June,

1920, 59, No. 6, 449–453. — "Group insurance," writes Mr. Rice, "is not . . . an instrument provided solely to reduce labor turnover expense. . . . It is rather the medium through which employer and employee may coöperate to the advantage of both in raising the standard of living and working conditions in the industry." The employer's interest is in no wise paternalistic, but has the same basis as that which prompts him to provide wholesome working conditions.

While a great deal has been done to improve the physical condition of the worker on his job, relatively little attention has been paid to the mental states which may affect him, and through him have a bearing upon production. The worker should be relieved as far as possible of worries such as those arising from the possibility of loss of income to his family through illness, accident, or death befalling him.

The employer's interest in group insurance has a certain tangible financial measure. When a worker stays on a job or in the employ of a firm for a considerable time, he is saving for his employers the sum of money which would be required to break in a new worker. It is suggested that this saving become the basis for the employer's payment toward a group insurance fund. In answer to the criticism that this money should be paid to the worker as wages and the question of insurance left entirely to his volition, the writer points out that the average worker of today has not reached the point where he appreciates the value of insurance. He would not insure himself if the group opportunity were not afforded him.

There are three major divisions of group insurance:

1. Group disability insurance — "Compensation to the worker for loss of time due to sickness and accidents not already provided for under compensation acts."

2. Group life insurance — "Compensation to the worker's family for loss through death while in service."

3. Group annuities — "Compensation to the worker due to old age incapacity or total incapacity before reaching the retirement age."

In administering group disability insurance the writer recommends that payments be made to disabled workers on the basis of fixed daily amounts rather than on the basis of a percentage of wages.

In the discussion of group life insurance, it is recommended that the idea be presented to the workers in a plant through a committee of their fellows. In this way the idea will receive the criticism and final sanction of a representative body of the workers themselves.

In a plan recently advanced by insurance companies, annuities beginning at a predetermined age may be provided for by the setting aside with insurance companies of a sum each year to cover these annuities. The employer is protected from excessive burden by such provisions as the pension age, and a specified term of service before an employee becomes eligible to old age pension protection.

In concluding, the writer calls attention to the Westinghouse plan, by which group insurance has been made a means toward stimulating thrift through systematic saving. — C. H. Paull.

Recent Progress in Social Insurance throughout the World. *Olga S. Halsey.* Am. Labor Legis. Rev., June, 1920, 10, No. 2, 151–154. — The writer presents a brief review of social insurance legislation recently enacted. New health insurance legislation was provided in 1919 in Portugal, Czecho-Slovakia, and Poland. Social insurance legislation has been amended in Great Britain, Norway, Germany, and Austria.

In Portugal health insurance is made compulsory for persons between 15 and 75 years of age who work for less than a specified amount. In Czecho-Slovakia health insurance legislation applies to all persons (except public employees) who work for wages, regardless of the amount. Among the benefits of the act are free medical care (including obstetrical services), 60 per cent. of wages for thirty-nine weeks in case of illness, a maternity benefit of 60 per cent. of wages.

New legislation covering compulsory old age insurance has been enacted in Italy, Spain, Portugal, the United States, Uruguay, and Czecho-Slovakia. In the case of the last-named country, the insurance applies only to salaried employees. In Italy the income for the old age insurance comes from equal contributions made by the employers and employees and by the state. In Portugal employers are assessed 6 per cent. on all wages paid below a certain amount, insured workers are assessed $1\frac{1}{2}$ per cent. on their wages, and the state furnishes certain subsidies. In Spain

employers and the state make the first contributions toward old age insurance; workers begin to contribute after a certain initial period.

Unemployment insurance legislation has been greatly stimulated by conditions growing out of the termination of the war. Among the countries which have provided for the unemployed through government grants are Great Britain, Belgium, Germany, Austria, and Czecho-Slovakia. — C. H. Paull.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

Disability by Age and Occupation. *Boris Emmet*. Mod. Med., Sept., 1919, 1, No. 5, 379–384. — To arrive at the actual extent of sickness among wage-earners, the United States Bureau of Labor Statistics made an intensive actuarial examination of the disability experience of the Workmen's Sick and Death Benefit Fund of America; a mutual sick and death benefit association, in existence since 1884, and operating on a national scale. The society confines its disability membership almost exclusively to male wage-earners, eighteen years of age and over. The disability experience examined represents the average annual sickness for the five-year period ending December 31, 1916, and is, therefore, free from accidental variations such as, for instance, those caused by the Spanish influenza epidemic of last year. The disability experience of 40,000 wage-earners in forty-two occupations is recorded. It was found that the average number of days lost for all occupations was 6.61 days each year. Certain occupations (miners and freight handlers) had a disability rate as high as 9.7, while others (professional men) had as low a rate as 2.6 days each year. It should be noted, however, that some of the highest disability rates are partly due to the inclusion of industrial accidents which were particularly heavy among such occupations as mining and freight handling.

"The conclusion is unmistakable that there is wide variation in the amount of sickness borne by workers in different occupations. Freight handlers, for instance, suffered 47 per cent. more than the average, although the average age of this group was three years less than the average age of the total. At the opposite extremes the professional workers suffered 56.1 per cent., jewelers, 43.9 per cent., and trade and clerical workers 30.3 per cent., less than the average. Comparisons, of course, must take other elements into consideration. The living conditions of different groups are different. The intelligence of the groups varies. The wages and consequent ability to obtain a decent living varies and the hours of work are also different. But it can readily be seen by measuring certain occupations with other occupations in which conditions are very similar that the factor of occupation is a steady one as a cause of sickness." — C. K. Drinker.

Duration of Wage Earners' Disabilities. *Boris Emmet*. U. S. Bur. Labor Statis., Month. Labor Rev., March, 1920, 10, No. 3, 4–15. — The present study was undertaken for the purpose of revealing the duration of disability as influenced by age and occupation. The figures are for the years 1912 to 1916, inclusive, and represent the experience of the Workmen's Sick and Death Benefit Fund of the United States of America. Disabilities resulting from accident as well as those caused by sickness are included. Tables are given to show: (1) the duration of disabilities among wage-earners; (2) the influence of age upon disability; and (3) the effect of occupation upon disabilities. — L. A. Shaw.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II | NOVEMBER, 1920 | NUMBER 7

CONTENTS

GENERAL

THE HYGIENIC CONTROL OF INDUSTRY IN THE PERIOD AFTER THE WAR. *Alfonso di Vestea.* Il Lavoro, May 31, 1920, 12, No. 1, 7–11. — Di Vestea considers the special evils of war-time industry under four heads: first, a serious deterioration of the population with a greatly increased proportion of invalided, blind, lame and mutilated; second, an increase of epidemic diseases, notably tuberculosis and malaria; third, an increase of vicious habits, abuse of alcohol and tobacco, and sexual indulgence; fourth, labor carried on under great stress resulting in exhaustion and in a greater frequency of accidents.

Before the war the population of Italy had already been impoverished by the emigration of young men, especially in the southern provinces where the resulting over-proportion of women to men reached 374 to 292 in Abruzzo-Molise, in the year 1911. The war has of course greatly increased this unnatural condition, and particularly in those very provinces where emigration had already left its mark. The author emphasizes the necessity for legal safeguards for women and children in industry if the population is to be made normal again, the protection of pregnancy, of the puerperium, of infancy and childhood. Physical education must be carried on in the schools and the crusade against tuberculosis supported. All such measures are needed most in the south where malaria is endemic and where, according to the figures of 1911, the expectation of life is far below that in the provinces of the north and center. In Puglie it is only 44 years and 8 months as against 54 years and 9 months in the center.

The housing situation calls for urgent reform, and this should take precedence over such measures as the eight-hour day, for though shorter hours are a benefit if the workman's home is healthful and pleasant, they may be the contrary if this is not the case. The experience of

physicians in the mercury mines of San Salvatore dell' Amiata showed that when the working day was shortened in order to diminish mercurial poisoning among the miners the result was most disappointing; mercurialism was actually increased because the miners, unwilling to spend their leisure in their squalid, crowded homes, spent it in the wine shops. — A. Hamilton.

The Necessity for an Institute of Industrial Hygiene. *Charles Baskerville.* Mod. Med., May, 1920, 2, No. 5, 363–364. — "Progress in chemical industries must of necessity carry with it a parallel improvement in the hygienic conditions of chemical workers, where the relation of disease to occupation has been established. It should not, however, be necessary for each separate industry to discover right conditions for their men, for trial and error in this field cost in health and human welfare. An endowment must be found to sponsor the co-ordination of all research agencies in chemistry, for the compilation of all data to present achievement, and for the direction of future activities."— M.C. Shorley.

Opportunities and Responsibilities of the Physician of Today. *Frank L. Rector.* Jour. Am. Med. Assn., Sept. 4, 1920, 75, No. 10, 651–654. — A plea for a better realization on the part of the physician of the character of his responsibilities in present day medical work. Since he must in the end bear the main burden in all types of preventive medicine, he should not enter such movements as an individualistic executive agent after they have been organized and started by laymen but should be part of the driving power from their very inception. — C. K. Drinker.

The Medical and Allied Professions as a State Service. *D. F. Harris.* Scientific Monthly, Sept., 1920, 11, No. 3, 235–245. — There is no valid reason, other than an historical one, why the scientific cure of diseases should not be a state service as much as the scientific prevention of diseases. The Indian Medical Service affords an example of such a state-managed service, which might well be extended. Under this system promotions, disability pensions, and the like would all be provided for by regulations like those of the Civil Service. The state would take over the problem of research in medicine, and co-ordinate all efforts. Study of the history of medicine shows strong tendencies in the socialistic direction. Differentiation is taking place, and there is a growing interest in the welfare of groups or sections as distinguished from individuals: soldiers and sailors as such; boys under fourteen; those suffering from venereal diseases; prisoners; the destitute. All such as classes become special problems, and we see societies for promoting the welfare of policemen, postal officials, illiterates, immigrants, ex-convicts, etc. It is a day of "sanitarily minded humanitarianism." At the present time, it is the health of sections of the community that is the concern of governments — the health of miners, or of workers in potteries, or of wool sorters as such. We have become communistic, institutionalistic, socialistic in the best sense, and the instituting of a state medical service is entirely in harmony with the general trend of an ever-widening humanitarianism. — G. E. Partridge.

Medicine and Social Reforms. *L. Devoto.* Il Lavoro, June 30, 1920, 12, No. 2, 33–43. — L. Devoto urges the appointment of industrial physicians, with trained nurses as aids, for the prevention of occupational disease. As a field in which the need is specially great he mentions the mines of Sicily with their high rate of ankylostomiasis, a national disgrace which should be wiped out as pellagra is being wiped out. As for the latter, it did not undergo recrudescence during the war, as might have been expected, except in parts of the invaded regions where the population was obliged to subsist on a diet of spoiled maize. Physicians should realize that the appearance of a single case of pellagra is a warning that people are receiving an inadequate food supply and that measures must be taken to avert an outbreak of this disease.

Devoto looks to the newly enacted compulsory health and old age insurance law to control occupational diseases. He defends the eight-hour working day and holds that when workmen's dwellings have been reformed as they should be, there will be no increase of alcoholism as a result of the shorter hours. For certain specially fatiguing occupations, such as that of girl telephone operators, six hours are long enough. He pleads for more respectful treatment and more co-operation on the part of the public toward those members of the medical profession who are trying to bring

about hygienic and social reforms. — A. Hamilton.

Chronicles of Social Hygiene. *A. Elster.* Öffentliche Gesundheitspflege, 1920, 5, No. 2, 27–31. — Elster complains that the industrial branch of social hygiene has in recent years lagged behind the political aspects of the industrial question; the political interest is to be expected to produce better conditions in general, but positive results have been relatively lacking. He discusses the articles of the treaty (387–427) that relate to international labor organization. There are references to recent acts and statistics bearing on the frequency of sickness in several industries by years from 1913 to 1918. — G. E. Partridge.

A Physical Census in England and Its Lessons. Jour. Heredity, April, 1920, 11, No. 4, 190. — For the first eight months of 19t8 the number of medical examinations conducted by the National Service Medical Boards in Great Britain amounted to 2,080,709. Of the men examined not more than 37 per cent. were placed in Grade I; that is, only about one in three had attained the normal standard of health and strength, and was capable of enduring physical exertion suitable to his age. The experience of the board examining women medically for the national works was similar to that of the National Service Medical Boards. Preventable disease is responsible for the bulk of the physical disabilities, and this is a measure of the ravages which industrial life has made upon national health. Too little food, too long hours of work, too little sleep, too little play, too little fresh air, too little comfort in the home are factors, but the defectiveness is in part due also to the habits of modern civilization that have allowed the congenitally weak to survive and reproduce their kind. — G. E. Partridge.

Material and Physical Wretchedness of Italian Fishermen. Il Lavoro, June 30, 1920, 12, No. 2, 52–54. — In 1912, Somigli published a work on the fishing industry of Italy which he showed to be enormously behind that of northern Europe in the methods employed, the wages and conditions of work, and the character of the men employed. The Italian fishing trades have undergone little if any change in centuries, and where northern countries are using machinery, steam power, etc., the Italians are still hauling their nets by hand, using primitive fishing boats, and confined in their operations to shallow waters. No progress has taken place since 1912, and Italy is largely dependent on importation for her fish supply. The condition is an absurdity, for with a proportionately larger coast line than any other European nation she pays more for fish than does inland Switzerland. Her supply comes chiefly from Basel, Hamburg, and Bordeaux. The neglect of this industry has resulted in a steady decrease in the number of skilled sailors and fishermen in Italian waters and in the persistence of outworn method of work. — A. Hamilton.

Industrial Educational Problems. Nat. Assn. Corporation Schools Bull., June, 1920, 7, No. 6. — Contains brief articles on several of the educational problems of industry. There is a useful classified list of personnel activities, an account of the Goodyear Industrial University, and of the Educational Division of the Elliott–Fisher Company. — G. E. Partridge.

The Need for Progress of Industrial Education in England. Nat. Assn. Corporation Schools Bull., Aug., 1920, 7, No. 8, 337–340. — This is a report of an address by the head of the Corporation School of Lever Brothers, in England. The main provisions of the new education bill are summarized. An employer may choose one of four different ways to meet the provisions of the bill. He may simply release the young people for the required number of hours, leaving the rest to the Local Educational Authority; he may leave the purely educational subjects in the hands of the L.E.A., and by arrangement with them provide what is called the vocational section of continued education; he may provide the school buildings, the gymnasium, club rooms, etc., and leave the educational arrangement for curriculum, teaching staff, etc., in the hands of the L.E.A.; he may provide a school of his own for his young employees — what is usually called a work school. Such a school may be entirely financed by the company, or it may be recognized by the Educational Authority and receive the government grants in the ordinary way. — G. E. Partridge.

Summary of Conclusions in Vocational Education. *J. M. Brewer.* Education, Sept., 1920, 41, No. 1, 53–57. — The members of a

class in education have tried to formulate the principles of vocational education and to present them in a brief summary. "The compulsory part-time continuation school offers the most promising agency for providing the guidance and instruction needed for boys and girls in industry; its upper range should be extended to age 18, and attendance for eight hours per week should be required. The part-time cooperative school under public control offers the ultimate, the most helpful, the most democratic, the only practical solution to the complex situation created by the imperative need for vocational education in modern life. . . . Schools in stores and factories, including vestibule schools, are supplementary and specific in character, and are legitimate expedients that may be used to provide immediate skill, but are in no sense a substitute for the more general and socially necessary education provided under public control. . . . Extension courses, dull-season courses and up-grading courses should be developed more extensively, closely correlated with actual trade conditions, and provided for adults as well as minors. Evening schools . . . will continue to be desirable. Attendance at either evening or part-time continuation day schools should be obligatory for employed miners under 18. Correspondence schools . . . should be provided at public expense. . . . Home projects should be made the basis of practically all agricultural education in intermediate and secondary schools." — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

MENTAL

Body and Mind. *Fred. W. Mott.* Lancet, Aug. 21, 1920, 199, No. 5060, 383–387. — This is a powerful plea for the more exact study of the mental defects and characteristics of the individual, in order to gauge his worth for either a military or civil occupation.

The writer points out that the war has produced no new nervous diseases, but has only brought to light the signs and symptoms of hysteria and neurasthenia (excluding, of course, direct injury to the brain) which were latent in the person. Nervous or mental inferiority was not considered sufficiently as a cause of rejection in the army for general service, and the nation is now paying a heavy price in the matter of pensions. One-third of the unwounded in 1917, discharged as unfit for service, were men suffering from war neuroses and psychoses. A large proportion of the civil population are potential neuropaths, or psychopaths, as all experienced neurologists know, and this branch of medical training is greatly neglected, much to the nation's loss. — R. Prosser White.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Carbon Monoxide Poisoning with Peculiar Cause of Origin. *Holtzmann.* Zentralbl. f. Gewerbehyg., April, 1920, 8, No. 4, 73–74. — The author describes two cases (one fatal) of poisoning from the evolution of carbon monoxide gas from the charcoal and organic constituents of specular iron during casting. According to Münker, gases evolved from this iron contain 19.1 per cent. carbon monoxide. Heavy atmosphere on the day of the accident evidently prevented rapid diffusion of the gas. Two other cases resulted from poisoning during the removal of the same cast iron on the following day, showing that the gas was held within the mold. — M. D. Ring.

Poisoning by Arseniuretted Hydrogen. *T. M. Legge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 68–70. — "Prior to the year 1914, poisoning by arseniuretted hydrogen gas occurred chiefly in the manufacture of salts of zinc and in chemical works among workmen engaged in removing acid residue from tanks or stills by means of galvanised iron pails and metal shovels. In the years 1900–1913 isolated cases also occurred in such industries as the manufacture of wall papers and the bronzing of art metal. Cases of a similar character have continued to be reported and during the years 1914–1918 the following industries were concerned:—

Oil works, cleaning out tanks, 2 cases, one fatal.
Chemical works, cleaning out tanks, 4 cases, two fatal.
Chemical works, manufacture of zinc salts, 2 cases, one fatal.
Chemical works, zinc purification process, 2 cases, one fatal.
Brass foundry, bronzing of art metal, 2 cases.

"During the years, 1917 and 1918, increase in the manufacture of intermediate dyestuffs has led to a series of other cases, five in number, with 2 deaths; and the probable extension of this industry adds to their importance. The processes implicated have been those in which zinc dust and hydrochloric acid are used either together in a reduction process or the acid added, at a later stage in the manufactnre, as a solvent for the zinc hydrate, formed at the previous stage, and any unconverted metallic zinc. When the first cases were investigated, question arose as to the possibility of hydrogen being liberated from an alkaline solution, bnt subsequent investigation proved this beyond doubt.

"The occurrence of these cases of arseniuretted hydrogen poisoning has been due, in some measure, to the high arsenic contents of the acid used dnring these years. One of the fatal cases occurred on a plant (zinc purification) which had been in operation for 20 years.

"The risk of poisoning may in the future be minimised by the use of de-arsenicated acid, but the presence of arsenic in the metal still necessitates the greatest care being exercised in any manufacture where hydrogen gas is liberated in the presence of arsenic. The cases investigated show that even when a process is carried on in the open there is danger to the workmen, or where an exhaust draught is provided for the vessel in which the reaction takes place, this precaution may, under certain circumstances, be insufficient to protect the workers. Two severe cases occurred in the manufacture of an intermediate dyestuff at a covered vessel provided with such an exhaust, where the anemometer reading taken at the manhole through which the acid was added showed an exhaust equivalent to 180–200 linear feet per minute. The explanation of such cases may be that a sudden evolntion of gas, produced in some instances by a too rapid addition of the acid, neutralises the effect of the exhaust and allows the gas to escape into the face of the workman. Complete enclosure of the vessel, in which a slight negative pressure is maintained, with separate feed holes provided with valves, appears to offer the best solution of the difficulty, or where this is impracticable, *i.e.*, where a metal vessel cannot be used, an exhaust draught must be maintained at the feed holes considerably greater than that referred to above.

"The exact interval of time which elapses between exposure to the gas and the onset of symptoms is difficult to determine, owing to the absence of any distinctive physical feature by which the gas can be readily detected. The smell of garlic attributed to the gas has never been observed by any of the persons affected. Generally several hours would appear to intervene before the first symptoms manifest themselves. In one case where frothing of the contents of the vessel occurred and thus was taken to indicate the escape of gas the man employed became affected after six hours. A point of considerable interest in connection with these cases is the difference in the severity of the symptoms produced by the gas on individuals who are apparently equally exposed. Where two men were doing the same work at the same time, one was very dangerously ill, while the other escaped with no symptoms. The explanation of this phenomenon is difficult.

"The symptoms observed in the cases under review have all been classical, commencing with abdominal pain, vomiting and diarrhœa, followed after an interval of 18–24 hours by jaundice and the passing of urine discoloured by blood pigments. The six fatal cases have terminated with the prominent symptom of suppression of urine, and the length of illness in these has varied from 4–8 days. The symptoms produced by inhalation of arseniuretted hydrogen gas have hitherto been regarded as due to the action of the gas on the blood, which breaks down the red blood cells and is followed by failure, partial or complete, of the liver and kidneys to eliminate the débris. Other poisonous gases, which are known to affect the red blood cells, cause rapid death by asphyxiation, and it has been difficult to reconcile this with the slow effect of an isolated inhalation of arseniuretted hydrogen gas, although the action of the gases on the red blood cells, assuming this explanation to be a correct one, would be very different. Further light has been thrown on the phenomena observed by investigations into a fatal case which occurred in 1917.

"The post-mortem of the case did not reveal

any very striking changes to the naked eye. Some of the organs were subsequently submitted to Professor Delépine whose report showed distinct degenerative changes in the liver and kidneys. Many of the cells of the liver were found to be vacuolated, and others, chiefly in hepatic and portal zones, were pigmented; the reddish brown pigment being in the form of fine granules, none of which gave the reaction of free iron with ferro-cyanide of potassium. Vacuolation and marked degeneration were also observed in many of the secretory cells of the kidneys. The extent of the degeneration of the cells is suggested by Professor Delépine, who in his report states: 'It is possible that necrosis of the renal epithelium is more advanced than the usual histological reaction would indicate, and that the nature of the poison has altered the usual reactions of the nucleoplasm.' Analytical analysis of a portion of the liver showed that 0.01 mg. of arsenious acid were present in 200 gm. of the liver, equivalent to 0.0000878 gm. for the whole organ. These findings seem to indicate that arseniuretted hydrogen, when inhaled, produces changes in the cells of the liver and kidneys, and that the symptoms are in some measure due to these changes. Probably changes are produced by the arsenic which gains admission by the blood stream, and it may be that an organic arsenic compound is formed in the red blood cells which, when it reaches the liver and kidneys, produces changes, particularly in the excretory cells. Such an explanation would link up these cases of poisoning with cases of jaundice which occasionally occur after the introduction of arsenic compounds into the blood stream. The disparity of symptoms might be accounted for by the difference in the media concerned, the one being arterial and the other venous blood, the presence of the oxygen compound being possibly an important factor in the formation of the toxic arsenic compound.

"Estimation of the arsenic in the urine of two cases of poisoning . . . showed in one case the presence of 790 mmg. of arsenious acid in 100 c.c. of urine on the sixth day after onset of symptoms, and in the other 35 mmg. in 100 c.c. on the eleventh day. Neither of these cases proved fatal. Examination of the urine of men apparently unaffected and engaged on a process which exposes them to the risk of inhalation of arseniuretted hydrogen gas has been carried out, without, at present, any definite results being obtained, the quantity found, under 10 mmg. per 100 c.c., being regarded as without significance. It is proposed to carry the examination further and the results obtained may throw light on the cumulative action of the poison. This, if proved, would help to explain the different effects of the gas on individuals apparently equally exposed to a sudden excess.

"Periodic examination, however, of the urine of the men engaged on processes involving exposure to the inhalation of arseniuretted hydrogen gas is unlikely to prove of much value as a preventive measure. Excretion of an excess of arsenic in the urine may be an indication of the ready elimination of the metal from the system preventing a cumulative effect, or on the other hand, as seems more probable, from the results of the examination of the urine of those severely affected, the elimination of arsenic is high where the excretory cells have been damaged, that is, when the symptoms have developed. Safety in working such processes, therefore, depends at present upon the efficiency of the measures taken to prevent the escape of the poisonous gas."

Poisoning with Hydrogen Sulphide. *Tauss.* Zentralbl. f. Gewerbehyg., April, 1920, 8, No. 4, 74. — In six instances men cleaning vats in which leather had been left in water to soften were immediately overcome by hydrogen sulphide gas. Two fatalities occurred under the same conditions. The source of the poisonous gas lies apparently in the solution of organic substances of the skins together with preservatives with which they have been treated.

A similar accident befell three men cleaning a kettle in a nutrient fat factory, presumably from the formation of hydrogen sulphide from the sulphur of protein after the decomposition of the gelatinous materials. In this instance two of the cases were fatal.

The author suggests preliminary ventilation and removal of gases by steam as preventive measures. — M. D. Ring.

The Toxicity of Picric Acid. *F. Koelsch.* Zentralbl. f. Gewerbehyg., Nov., 1919, 7, No. 11, 185–187; Dec., 1919, 7, No. 12, 223–228. — Earlier writers disagree as to the toxic effects of picric acid. It has been stated that like most nitro compounds it has the tendency to decompose the formative elements of the blood with production of methemoglobin. Lowering of the red blood count and simultaneous leucocytosis have also been attributed to it. Later writers

have stated that the blood is unchanged. Independent of the blood action is the possibility of the production of convulsions through stimulation of the central nervous system. A third possible activity lies in the extraordinarily great protein decomposition which takes place in acid solution, *i.e.*, in organs where an acid reaction obtains as in the gastro-intestinal canal and kidneys where necrotic tissue changes can appear.

The general symptoms are fever, headache, dizziness, partial unconsciousness even to somnolence and collapse; inflammation of the skin and mucous membranes, jaundice, erythema, rash similar to measles, scarlet fever or urticaria, vomiting and diarrhea; albumin and blood in the urine. The lethal dose is not clearly known. In therapeutics single doses from 0.2–1.0 gm. and daily doses of 0.1–2.0 gm. are taken internally. Doses from 20 to 25 gm. can be endured.

The author quotes cases described in the literature where bronchitis, cough, dyspnea and general disturbances, such as weakness and anemia, are attributed to breathing dust containing picric acid. His own experience is based on observations in many factories where there was considerable dust and smearing of the body surface of the workers. Even after a few minutes' stay in the workroom a characteristic bitter taste is detected in the mouth, and mustaches and nasal openings are stained yellow. In a relatively short time the workers exhibit the characteristic yellow or olive-green color of hair, and yellowed skin. Inflammation of both skin and mucous membranes was observed, the former especially in the hot seasons. In one case a swelling in the mouth and pharyngeal cavity, first mistaken for diphtheritic process, was observed. Severe cases of pneumonia were not directly traceable to this agency. Fairly frequent complaints of gastric disturbance were made. No action upon the reproductive organs of the numerous women examined was observed. A history of one case diagnosed as gastric catarrh and neuritis resulting from picric acid poisoning is detailed. This victim was undoubtedly hypersensitive to the acid.

The author outlines a method for the determination of picric acid in the urine or blood. He obtained positive results in one case out of six.

Prophylaxis is undoubtedly necessary. Careful avoidance of dust, protection of the body through gloves, working clothes, washing of hands with soap before meals, rinsing of mouth with tincture of myrrh, and exclusion of workers with open wounds should be insisted upon. Thorough powdering of the face before work protects against yellowing of skin; washing the face with whey is also recommended.

Dr. Koelsch concludes, however, that picric acid as used in munitions factories is a relatively harmless substance. Tolerance toward it is very extensive unless there is a pronounced sensitivity. He has never observed cases of acute or chronic poisoning. Such transitory symptoms of irritation as may appear are easily avoided by good management of the industry and by care and personal cleanliness on the part of the workers. Special hygienic provisions are apparently not necessary. — M. D. Ring.

Acute Methyl Alcohol Poisoning. *Raphael Isaacs.* Jour. Am. Med. Assn., Sept. 11, 1920, 75, No. 11, 718–721. — The author concludes with the following summary:

"1. Wood alcohol appears to vary in its toxicity to different individuals.

"2. The symptoms are those of depression of the medulla and the cranial autonomic system and at times the sacral. There is usually a marked and early effect on vision.

"3. There is a rapid disappearance of the symptoms (unless the anatomic injury is beyond repair) with intensive alkali therapy.

"4. Many of the toxic symptoms probably accompany the acidosis, which may be associated with the acid production (formic) and with methemoglobinemia." — C. K. Drinker.

Mercurial Poisoning. *T. M. Legge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 70–72. — "The figures for mercurial poisoning show an increase in the years 1916 and 1917 — caused by the greatly increased use of fulminate of mercury in filling detonators. Only a few of the cases from this cause, however, show the recognised symptoms of mercurial absorption — salivation, tremor and 'nervousness.' The great majority were cases of dermatitis or eczematous ulceration of the face, neck, hands and forearms, associated with conjunctivitis and inflammation of the nasal and laryngeal mucous membrane. The finer the powder the more irritating it is to the eyes and nostrils. The condition is very quickly set up — the reports on the cases frequently showing as short a time of employ-

ment as two or three weeks. The cases are but samples and there must be few who come in contact with the fine powder who do not suffer more or less from its effects. Unfortunately, the high explosive nature of the substance renders it quite impracticable to require mechanical means of ventilation, and, indeed, operations have to be conducted so carefully that no dust is visible. Use of a 10 per cent. solution of sodium hyposulphite (1 lb. to a gallon of water) aids in the prevention of the ulcers and rash, and the workpeople were directed to dip their hands in a basin containing the hyposulphite solution before breakfast, dinner, and leaving at night. Similarly, in the conjunctivitis, use of a 2 per cent. solution as an eye-wash has been found beneficial. I give below an interesting account by Dr. J. B. G. Skelton, . . . who was asked to make an intensive study of the conditions in the factory where most trouble was experienced, the amount of absenteeism and the number of cases of compensation at one time being considerable. In the last six months of 1916 the certificates numbered 345 and in the first half of 1917, 232. An interesting point brought out by Dr. Skelton is that the supply of a towel to each worker seems to have been more important in reducing incidence than anything else.

"The section is engaged upon the mixing of mercury fulminate compositions and the filling and pressing of it into percussion caps. There are 255 women, of whom 55 are employed in the mixing shed, and 200 in the machine shops. No men are employed.

"The cap composition containing mercury fulminate is mixed by hand, and in comparing this method with that of machine mixing, the manager of the cap factory stated that in his opinion the mixture was more complete and the resulting compound more stable when hand mixed, although machine mixing required fewer workers. At the beginning of the war the number of workers was suddenly increased to about 500, and the work was done in three eight hour shifts, and the management is inclined to attribute the numerous cases of rash and conjunctivitis which appeared among the workers in the early days to the general overcrowding.

"Before each mix the floor and benches are washed down. After mixing, the composition is taken to a conditioning room and spread out on trays to dry in the air till the right degree of moisture is obtained; if too dry it is sprinkled with water. The conditioned powder is next rubbed into depressions in a plate by hand. This plate is then inverted and superimposed upon another which contains empty caps, corresponding with the depressions on the first plate. The inverted plate is next tapped with a small mallet so that pellets of the composition fall into the caps. The tray of caps is next taken to the machine sheds.

"The commonest effects seen are conjunctivitis and dermatitis, including 'powder holes.' It seems curious that the eyes should be affected by the manipulation of a damp powder especially as dust in this process would be extremely dangerous and is very scrupulously guarded against, and it seems to me that at least an element in the production of eye trouble and erythema of the face must be rubbing with the hand during work. A 'powder hole' appearing at the sides of the fingers usually over the terminal digit must be accounted for by a moist sweating skin constantly irritated by the sharp crystals of mercury fulminate and the other ingredients of the powder.

"*Precautions.* — Gloves and respirators are not used in the factory and would, I think, do more harm than good. Goggles have been used but were much disliked by the girls and perhaps caused eye rubbing. A pail of sodium hyposulphite is kept outside the mix sheds for the girls to rinse their hands in before washing and a weak solution of this substance is used for bathing the eye, if affected. Obviously, in dealing with irritating powder, good washing facilities and an abundant supply of clean towels are essential and these seem to have been lacking in the past. The weekly number of towels used in the cap factory was for the week ending December 14th, 1917, 2 towels; week ending February 2nd, 1918, 26 towels; week ending March 2nd, 1918, 98 towels; week ending July 13th, 1918, 117 towels. The washing accommodation consists of 30 basins in one lavatory and 28 hot taps over troughs in the other. Towels are changed daily and washed by an outside washerwoman who has never suffered from dermatitis. Overalls are not changed until worn out.

"*Medical arrangements.* — A surgeon visits once a month and sees all suspected cases due to mercury at his house. Compensation at the rate of half wages is paid on his certificate. He gave me the following figures from his books: — March, 1918, 10 cases; April, 1918, 4 cases; May, 1918, 4 cases; June, 1918, 3 cases; July (to the 16th), 6 cases. They were all conjunctivitis or pharyngitis. He had never seen a case of mercury absorption due to fulminate, and said that the number of cases had shown a very rapid decline. He also gave it as his opinion that the highest incidence of throat troubles occurred in the winter and were not in all cases due to the powder.

"In the early days when work on fulminate was being pressed forward and three shifts were worked, the number of cases was high, but since May 22nd, 1917, when two day shifts were worked, the number began to fall, this fall being accentuated on July 31st when one day shift only was worked. Accompanying the fall in the number of cases per week is a gradual decrease in the number of employees and a steady increase in the number of towels.

"It is worth while to summarise the 208 cases of mercurial poisoning between May, 1899, when mercurial poisoning first became notifiable, and December last. The distribution is as follows: — Thermometers, 45; Fulminate in powder factories, 54; Hatters' furriers, 27; Electrical meters, 24; Felt hat industry, 19; Chemical works, 19; Water gilding, 12; Lining sweet moulds, 4; Mercury lamps, 3; Bronzing, 3; Card dressing, 3; Photo-engraving, 2; Other, 2.

"With mercurial poisoning, even more than with lead, the cases reported are merely an indication of the amount of absorption occurring among the workers. Especially is this the case in the manufacture of philosophical instruments, in which the making of clinical thermometers, generally described in the trade as 'glass blowing,' constitutes an important branch. During the war this industry was very busy, and controlled by the Ministry of Munitions. A large number of apprentices, both boys and girls, were taken on — a very desir-

able thing in view of the skilled nature of the industry, could it only be freed from risk to health. This was brought home to the manufacturers themselves when parents showed reluctance to allow their children to undergo apprenticeship, and naturally, there has been anxiety to improve the conditions of work. Already among the cases reported have been a few of these young persons, while others examined at work showed evidence of mercurial absorption. The premises in which the trade, largely centred in Clerkenwell, is carried on, are particularly difficult to improve. The consumption of gas is considerable and ventilation by mechanical means is considered to be out of the question on the ground that any draught would tend to crack the hot glass. Recently, however, improvements in the methods of manufacture hold out a prospect that danger will largely be removed in the making of thermometers. A committee of the employers is now going fully into the question of improving conditions as regards (1) ventilation, (2) cleanliness, (3) smooth surfaces for the benches, (4) periodic medical examination, and (5) cloakroom, messroom, and washing accommodation.

"Three of the cases have occurred in the manufacture of mercury vapour lamps, and three unusual cases occurred in rubbing a mixture of tin and mercury onto tins for baking sweets. The mixture is rubbed on so that the gum can be pulled off the tin without sticking. The mixture, after having been rubbed on the tins, had to be brushed and it was in inhaling the dust whilst brushing that the three somewhat severe cases were contracted. The process has now been given up.

"Another unusual case was that of melting metal ingots in crucibles in a furnace and subsequently adding an amalgam, reheating, and pouring the metal into moulds. The mercury in the total content was only between 2 and 3 per cent. Danger of mercury arose in the pouring of the metal and in the skimmings and residue from the crucibles thrown on the floor. Dr. Bridge examined 12 workers employed from a few weeks to six months, and found seven showing symptoms of absorption. Localised exhaust, and proper receptacles for the dross were called for.

"Attention was called to the risk of mercurial poisoning in the manufacture of cyanide gauze dressings and bandages, owing to the dust given off as the material is lapped. In one factory, periodic medical examination was instituted in the execution of a large order."

Studies on Industrial Mercury Poisoning. *F. Koelsch* and *H. Ilzhöfer*. Zentralbl. f. Gewerbehyg., Jan., 1919, 7, No. 1, 11–16; Feb., 1919, 7, No. 2, 17–27; March, 1919, 7, No. 3, 42–52. — Although industrial mercury poisoning was prevalent in 1885 among the workers engaged in silvering mirrors, after 1891 it was practically completely stamped out by means of energetic measures of sanitation and the substitution of silver deposits for the mercury. But from January, 1917, to the end of May, 1918, sixteen cases were reported, owing to the increased use of mercury and mercuric oxide in chemical industries.

Workers evince an individual sensitiveness to the poison; weakness, anemia, convalescence, and youth predispose toward infection, while alcoholism and even lack of personal cleanliness are factors. The mercury may enter the system either through the lungs as vapor and thence into the circulation, or it may condense in the mucus of the upper air passages and pass directly or through swallowing with the saliva into the alimentary canal. It may also be taken in as dust through the skin or by swallowing dust particles from the upper air passages. From this, there results a deposition of mercury in the liver, intestine, kidney, spleen, bone marrow and testicle. Elimination is slow, mercury remaining longest in the liver and the bones. The excretion takes place through all of the glands of the body, especially through the salivary, intestinal and gastric glands, and through liver, kidneys and sweat glands. The symptoms of poisoning are the result of active stimulation in the place of elimination, producing salivation, stomatitis, inflammation of the salivary glands; intestinal irritation, tumors of the colon; increased bile secretion, as a result perhaps of destruction of numerous blood cells in the liver; albuminuria, polyuria or oliguria, epithelial necrosis with deposits of calcium acid carbonate, cirrhosis of the kidney; and skin diseases, according to the seat of irritation.

Aside from these pathological conditions, there is a direct action of the poison on the central and peripheral nervous system, with degeneration of medullary sheath and of ganglion cells. Vasomotor nerves are also injured. Parenchymatous and fatty degeneration appear in organs with destruction of many red blood cells. Irritation of bone marrow and perios-

teum may lead to ostitis, decalcification and necrosis of the bone. Finally metabolism is affected. This is increased by small doses, but large amounts of mercury induce a lessened oxygen capacity of the cells with rapid decomposition of glycogen.

Clinical symptoms are as follows: (1) stomatitis leading to purulent gingivitis; (2) general destruction of organs characterized by somnolence, night sweats, etc.; (3) erythema mercurialis, timidity, anxiety, embarrassment, trembling of hands and tremor of tongue; (4) tremor mercurialis; cachexia, with pale sallow face, falling hair, cold extremities. Even five to six months of exposure to mercury can suffice to produce severe cases of tremor and cachexia.

The author describes methods of determination of amounts of mercury present in urine and in the air. He states that 0.4 to 1 mg. of mercury daily for a month is a sufficient amount to produce symptoms of poisoning. Of the twenty-five persons examined for the presence of mercury in the urine, 80 per cent. gave positive results. — M. D. Ring.

Arsenic Poisoning. *T. M. Legge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 67–68. — "The increase of reported cases from three in 1915 to thirty in 1917 was due partly to the increased number of cases (nine), of which an account is given later, from arseniuretted hydrogen gas poisoning, but mainly from the manufacture (for purposes of chemical warfare) of arsenic trichloride by the action of sulphuric acid on a mixture of common salt and arsenic, from whence it distilled over and was condensed as an oily liquid and filled into drums. The plant was difficult to keep free from leaks, and the arsenic chloride permeated the air near the place where the men were working. The effect was to produce an intense irritation, showing itself in eczematous ulceration of the face, nose, hands and other parts of the body to which the vapour might gain access, especially those parts liable to excessive sweating. The mucous membrane of the eyes, nose, throat and bronchial tubes was attacked in the same way.

"In one case death was due to an accident in the manipulation of the apparatus which led to a burn on the leg extending from the knee to the ankle and half way round the leg, in a man, aged 46. Professor Delépine, who made the post-mortem examination, and examined the tissues, reported that death was due to absorption of arsenic. The microscopical examination of the organs showed that the heart, liver, kidneys, pancreas, and the gastric and duodenal glands were in a state of granulo-fatty degeneration. Arsenic was also found in considerable quantities in the various organs. It was impossible to determine to what extent arsenic absorption had taken place through the skin, but Professor Delépine expressed the opinion that the amount of arsenic found in all the organs examined indicated that some soluble compound of arsenic had been freely distributed through the body, in all probability by the blood and lymph. Examination of the hair and urine of other men working on the same plant showed the presence of material quantities of arsenic and indications of degenerative changes in the kidneys. Had the process been continued, further examinations of the urine would have been called for in order to determine the question of the advisability of the men continuing their employment. The symptoms of arsenic trichloride are thus shown to resemble those with which we are familiar from contact with the dusts and salts of arsenic, namely, ulceration of the skin, and quite different from those produced by inhalation of arseniuretted hydrogen gas, cases of which have particular interest owing to their unexpectedness, and are described below by Dr. Bridge. The pathological changes in the liver and kidneys, however, have a certain similarity which deserves attention.

"Two other cases of ulceration of the skin occurred in men who were manipulating sludge containing arsenic from acid coolers in the manufacture of sulphuric acid."

Ulceration and Perforation of the Nasal Septum caused by Bichromate of Potassium. *A. Ranelletti.* Reviewed from Il Policlinico, 1919, in Il Lavoro, May 31, 1920, 12, No. 1, 19–22. — During the war the author had occasion to observe cases of lesions caused by bichromate of potassium in a factory making chlorate of sodium by electrolysis. Among sixty-nine operatives, thirty-eight had ulceration of the nasal septum, six of them having complete perforation. The ulcers begin with an area of hyperemia which soon changes to a pale yellowish grey spot, roundish and fringed, about the size of the head of a pin up to a diameter of 2 cm. Then excavation begins into the mucosa and the cartilage; finally perforation occurs, the opening being round or oval, with smooth

borders and always of a whitish yellow color. There is no attempt at repair, no hyperemic reaction; the loss of tissue is permanent. The process takes place without pain and the victim is often unaware that he has a perforated septum, although a catarrhal rhinitis may precede it. Such a rhinitis usually comes on after about a month or two of exposure, and in a few weeks more ulceration sets in. Perforation may be complete after a few months' employment. The cause is the inhalation of chrome dust which is carried by the inspired air against the septum of the nose. There are several occupations in which workers are exposed to such dust: the mining of chromate ores, the metallurgical extraction of the same, and the manufacture of chrome colors, of Swedish matches, etc. As preventive measures are recommended the control of dust so far as possible and the plugging of the nostrils with tampons of gauze impregnated with salicylic acid. — A. Hamilton.

A Method for Manganese Quantitation in Biological Material Together with Data on Manganese Content of Human Blood and Tissues. *Clarence K. Reiman* and *Annie S. Minot.* Jour. Biol. Chem., June, 1920, 42, No. 2, 329–345. — "A method is developed for the analysis of manganese in blood and tissue which is more rapid and has fewer sources of error than methods heretofore employed." A series of results is given for manganese content of human blood for normal subjects as far as manganese exposure is concerned. Check results on the same individuals at different times show general constant level of manganese in human blood.

"A series of results for the manganese content of human tissue obtained from fourteen autopsies is presented. Manganese was found in all the tissue analyses, the liver carrying the highest amount, averaging 0.170 mg. per 100 gm. wet tissue." — A. S. Minot.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Anthrax Problem in Massachusetts. *Stanley H. Osborn.* Am. Jour. Pub. Health, Aug., 1920, 10, No. 8, 657. — As a result of a detailed study of the incidence of industrial anthrax in Massachusetts it is shown that:

1. Anthrax-infected hides, hair and wool are being imported from foreign countries.

2. Anthrax-infected hides are being shipped chiefly from Buenos Aires, Argentine; Hankow, China; and Calcutta, India.

3. Federal regulations do not prevent the importation of infected material.

4. Hides bearing the consular certificate have apparently caused anthrax cases.

5. Hides, hair, and wool can in most cases be successfully disinfected for anthrax spores.

6. Anthrax cases operated on have a fatality rate double that of the non-operative cases.

The following recommendations for the prevention of anthrax are made:

1. Quarantine of all hides, wool, and hair from anthrax-infected and suspected areas or areas about which information is lacking.

2. Disinfection of all hides, wool, and hair from anthrax-infected and suspected areas or areas about which information is lacking. This disinfection should be done in the country where the hides, wool, and hair are collected, preferably at the market center, where, by mass disinfecting, a trained corps of workers could disinfect successfully, efficiently, and at the lowest cost.

3. An anthrax survey should be made by a corps of trained men, acquainted with anthrax and the hide and leather industry. This survey should consist of field investigations, to ascertain the prevalence of anthrax in regions where hides, wool, and hair are collected for export, and the manner of collecting and preparing the different products for shipping. The collecting of definite data by permanent investigators would enable a consul to have a far better knowledge of the hides, particularly of those on which he is requested to issue the consular certificate.

4. The disposal of sludge from hide vats should be cared for in such a way that no material can overflow the land and thus "seed" it with anthrax spores.

For the disinfection of hair, live steam for fifteen minutes on opened and loosened bundles is recommended; for wool the method used in England and described in the report of the Departmental Committee Vol. II, cd. 9171, is the method of choice; and for hides the only satisfactory method so far devised is that of Schattenfroh, or a modification of the same, consisting in a soak for forty hours at a temperature

between 60 and 70° F. in a solution of 2 per cent. absolute hydrochloric acid and 10 per cent. sodium chloride. — H. F. Smyth.

The Diagnosis of Anthrax from Putrefying Animal Tissues. *W. A. Hagan.* Jour. Bacteriol., July, 1920. 5, No. 4, 343–351. — A rapid diagnosis is often necessary, hence inoculation tests are at a disadvantage. The author describes a procedure whereby a diagnosis may be made in eighteen or twenty-four hours. The suspected material is cultured on agar plates and the typical anthrax colony recognized by means of the microscope. — Barnett Cohen.

Recovery of Streptococcus Hemolyticus from Restaurant Tableware. *C. C. Saelhof* and *W. J. R. Heinekamp.* Am. Jour. Pub. Health, Sept., 1920, 10, No. 9, 704–707. — The authors give the following summary of a series of sixty-three examinations of tableware in nine restaurants in Chicago:

1. Hemolytic streptococci were isolated from the washed dishes and tableware in small restaurants and cafes.
2. Six and thirty-five hundredths per cent. of the articles examined yielded this organism.
3. The strains of streptococcus hemolyticus were virulent for rabbits. They correspond to the human type.
4. For the protection of the public a better system of washing dishes is needed in the small eating places.

Besides the streptococci the following pathogenic organisms were recovered from eating utensils supposedly clean: pneumococci and B. coli once each, staphylococcus aureus thirty-one times, and staphylococcus albus twenty-three times. — H. F. Smyth.

Soaps in Relation to their Use for Hand Washing. *John F. Norton.* Jour. Am. Med. Assn., July 31, 1920, 75, No. 5. 302–305. — "Sterile hands are not obtained in the ordinary process of hand washing. More bacteria were found to be removed by the ordinary toilet soaps than by the special soaps. In other words, the cleansing properties of a soap are more important than its 'germicidal' or 'antiseptic' constituents.

"The soap solutions obtained in hand washing are of no practical germicidal or antiseptic value.

BACTERIAL CONTENT WITH RINSE WATER AFTER DRYING*

	Without Drying	After Drying
	580,000	17,500
	675,000	64,000
	1,760,000	238,000
	12,000	87,500
	17,000	52,500
	1,110,000	260,000
	144,000	30,000
	12,500	47,500
	72,500	23,800
	220,000	450,000
	46,000	2,630,000
		25,000
		3,000,000
Average	421,000	496,000

* The figures standing opposite in the columns have no significance.

"The soap left on the hands after washing has no germicidal action.

"In the whole process of hand washing done in the usual manner, the special so-called 'germicidal' or 'antiseptic' soaps exhibit none of these properties. Therefore, these terms are not proper to use in connection with soaps.

"Finally, since the hands may serve as a medium for the conveyance of bacteria in infectious diseases, it is important to remove these bacteria; and this may be done by the ordinary toilet soaps as effectively, if not more so, as by the special brands of so-called 'antiseptic' or 'germicidal' soaps." — C. K. Drinker.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Industrial Dermatitis. *T. M. Legge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 82–83. — "Dr. Bridge investigated the condition known as oil dermatitis which proved very troublesome in a large number of engineering works during the war, arising from the cutting oils, cutting compounds, and soluble oils used on automatic lathes and similar machines, and composed chiefly of mineral oil derived from the residue of petroleum left after distilling other oils which boil below 300° C. The malady has been known for a long time, having been described, with typical illustrations, in a paper by Dr. H. S. Purdon, in 1902, on *Acneiform Eruptions in Flax Doffers in Belfast.* The condition, Dr. Bridge says, closely resembles that seen in the green or paraffin sheds of the shale oil refineries,

but is milder in form. He describes the affections of the skin due to oil in engineering shops as, first, inflammation of the hair follicles (folliculitis or peri-folliculitis), secondly, septic infection, and thirdly, eczema. The hair follicles present the appearance of dusky red somewhat shaded papules, on the surface of the forearms and hands, and occasionally of the thighs. About the centre of each papule is a dark and somewhat depressed black spot. These inflamed follicles, produced by the blocking of the hair follicles and ducts of the sebaceous glands by a paste of oil and dirt, persist for a considerable time.

"Injury to the skin is the primary factor in the production of septic infection and as lubricating fluids contain fine sharp particles in suspension, mere movement of the fingers or leaning the arms on the work may produce sufficient injury to the skin as to cause the primary lesion, through which the germ enters. For prevention, cleanliness of the workers' hands and arms, and the removal of the oil and dirt, unavoidably present, is essential. Dr. Bridge describes as having proved satisfactory, not only in prevention, but also in curing the condition, washing with ether soap and powdering the arms before and after work with equal parts of zinc oxide and starch.

"Numerous inquiries into outbreaks of eczema arising out of conditions due to the war were made. It is remarkable how many of them were due to derivatives of coal tar, petroleum and shale oil, used as explosives or dyes (tetryl, picric acid, T.N.T., nitroso-phenol), and, therefore, probably due to the same essential cause as pitch and petroleum acne. Generally the substances setting up industrial eczema are, first, chemical irritants and caustic agents like bichromate of potash and arsenious acid and certain finished dyes; secondly, those which dissolve and remove the natural grease from the skin, such as turpentine, petroleum benzine, benzene, and its homologues, and the intermediate bodies, their nitro- and amido-derivatives; thirdly, processes which soften and macerate the skin such as alkalies; and fourthly, processes which mechanically injure the continuity of the skin, such as brushing, scratching and rubbing. With the oily and greasy material removed, the dry skin cracks, and the most important thing in prevention is to try and restore, as far as possible, the natural lubricant to the skin.

"If irritating powders are handled — and this has been especially brought out in connection with the use of tetryl (Prevention, symptoms and treatment of tetryl dermatitis by Enid Smith, British Medical Journal, 24.9.16; An investigation into the cause and prevention of industrial diseases due to tetryl, W. L. Ruxton, British Journal of Dermatology, Jan.–March, 1917; The properties of tetryl, Lucy Cripps, M.B., British Journal of Dermatology, Jan.–March, 1917) in the handling of which hardly any workers escaped an initial incapacitating attack of dermatitis — much the best preventive during work was found to be dusting the skin with a dry powder, such as talc and starch, rather than the use of an ointment, which tended to collect and retain the noxious powder. The spread of eczema from the hands to other parts of the body indicates that the pathogenic germs on the skin have set up a septic infection.

"Dr. Bridge and Mr. Verney investigated an outbreak of eczema in which 40 to 50 cases had occurred within 15 months of the starting of the manufacture of phenacetin in what Mr. Verney described as 'an old and unsuitable building, too small for the plant, and ventilated only through the door and by openings in the roof and near the eaves.' Seeing the conditions of manufacture, Dr. Bridge found it difficult to arrive at the exact cause, but believed that the intermediate products and acids used led to a drying of the hands with subsequent cracking and the formation of vesicles; while the phenol vapour accounted for an acute erythema and swelling of the face occurring so rapidly, as within an hour completely to occlude sight.

"Not a few outbreaks arose from the use of a strong alkaline solution known as 'lyco' used in cleaning old fuse caps. In one case the firm had been ignorant of the strength in which to use the solution and made it much too strong. The fuse caps, after inadequate washing, were scratch-brushed, with damage to the fingers. The burns disappeared on using the solution in proper strength, but the use of the scratch-brush was still a source of trouble. The recommendations made were (1) daily inspection of fingers; (2) application after washing in running water of impermeable waterproof plaster. At another factory where there was no scratch-brushing, the effect of the solution was most noticeable where the skin was kept moist, as under a ring.

"An outbreak involving over 30 persons occurred at a dye works in a weaving shed from

cops dyed a sky blue tint. Dr. Prosser White . . . attributed the cause of this outbreak to the powerful alkaline and caustic processes through which the thread would first pass, subsequently cleared by passage through a weak acid bath. The latter process had not been properly carried out, so that zinc and quick lime were concentrated on the thread."

Dermatosis Accompanied by Febrile Symptoms Caused by Direct or Indirect Contact with Spoiled Corn. *G. Romiti.* Reviewed from Gazzetta degli Ospedalia e delle Cliniche, 1919, in Il Lavoro, May 31, 1920, 12, No. 1, 22–23. — An epidemic of dermatitis accompanied by febrile symptoms was observed by the author in the fall of 1916 in the commune of Ponte Buggianesi, and during the same season of the three following years a smaller number of cases of the same affection was seen. The cause seemed to be contact with spoiled corn or even with the clothing of one who had handled such corn. A few minutes after such contact an intense itching would be felt, making the victim wash himself to get rid of the irritant. Even prompt bathing, however, would not prevent the further development of the attack. In a few hours an erythema appeared over the inner surface of the arms, the bend of the elbow, the inner surface of the thighs, and the neck, and quickly passed into a pemphigoid eruption, with itching. After six hours blisters would form and as they increased in size the erythema disappeared. Together with the skin symptoms, there was much restlessness, a severe headache, nausea, vomiting, and fever preceded by chilliness. The fever lasted from six to twelve hours and on the following day the systemic and local symptoms gradually improved. — A. Hamilton.

Clinical and Experimental Observations on the Effect of Carbide on the Human and Animal Skin. *Otto Sachs.* Wien. klin. Wchnschr., 1920, 33, 333. — Carbide used for making acetylene produces a dermatitis and later numerous punched-out sores similar to and of the same origin as those produced by lime. Finely pulverized carbide was rubbed into the skin of a rabbit's ear and a dermatitis resulted which was followed by necrosis. The same picture was obtained when water was added to carbide which was merely laid upon the skin. As a prophylactic measure, it is suggested that the hands of workers be rubbed with vaseline to keep away moisture. — Barnett Cohen.

Epitheliomatosis Ulceration among Tar Workers. *W. J. O'Donovan.* Brit. Jour. Dermat. and Syph., July, 1920, p. 215; Aug.–Sept., 1920, p. 245. — This is a well-balanced study of an interesting subject. The paper contains the clinical and pathological records of twelve in-patients and six out-patients treated at the London Hospital. The youngest sufferer from tar cancer was 33 years of age, and the shortest duration of employment before any lesion showed evidence of malignancy was ten years. The effects of pitch dust upon the eyes in cold weather are lacrimation, severe smarting, all forms of conjunctivitis and even ulceration. The skin smarts and is painful in pitch workers if exposed to the air, immediately after washing, especially in the summer months. Pitch warts are usually regarded by the employees as of little moment, but O'Donovan says "that any papilloma of 1 cm. in diameter which does not show signs of necrosis in three months, or loses its cap and becomes an ulcer with rolled edges is to be diagnosed as a tar carcinoma." He tells us that in one works employing only 350 men, the first quarter of 1920 furnished three cases of epithelioma.

From a tabular review of sixteen cases, he draws the following conclusions:

1. Ages vary of those affected with carcinomatous lesions.
2. Long duration of employment is common before any lesion becomes serious.
3. Operative treatment is needed for many growths which give only a short history.
4. In a few cases single lesions of long duration have required in the end to be removed.
5. Some tar warts may exist twenty-five years without showing any signs of malignancy, whilst a new lesion by its change of type and rapid growth will cause the worker to seek early surgical advice. The writer's experience is that malignant growths affect the face, scrotum and forearm in diminishing frequency. No scrotal cases were the result of pitch dust. In two instances the glands were enlarged and in one of these they showed malignancy. One carcinoma of eighteen months' duration proved to be inoperable.

Discussing the pathology of this disease, its recent study by Schamberg is reviewed and some parts of it quoted. The writer then proceeds to describe his own investigations. They

consist of the detailed examination of eight lesions removed from a case under his own care and the histology of five others preserved in the Institute attached to the London Hospital.

He points out that his findings are always constant. The keratoses are formed by great hypertrophy of the epidermis of one or more follicles. Dense masses of squamous and polygonal cells make up the cancerous growths and a wide, or narrow hypertrophied margin surrounds the "cell nests." Though the cell invasion produces excessive tissue reaction, he does not consider it becomes sufficiently dense to strangulate and thus cause necrosis. When this does happen, he is of opinion it is due to interstitial hemorrhage.

A review of the etiology and the work of investigators in this field of research concludes a valuable paper. The reader will probably rightly infer that the exact factor (or factors) common to a group of, or to individual coal tar products, which occasion these cancers, awaits further search. — R. Prosser White.

Pitch Ulceration. *T. M. Legge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1918, pp. 81–82. — "By an arrangement with the occupiers of the principal factories in South Wales for the manufacture of briquettes, reports have been obtained of cases of pitch ulceration, in several epitheliomatous in nature, which came to their knowledge. These cases were usefully followed up by inquiry by the certifying surgeon so that, for the years 1914–1918, particulars have been received of 64 men who have been affected, some of them more than once in the time stated. This is a very disappointing result, following on the inquiry which was made by Mr. A. H. Lush, in 1911, and again in 1913, into the need for regulations requiring washing and bath accommodation, overall suits, prevention of dust, and protection against injury to the eyes.

"The two factories, in which by far the most satisfactory arrangements for washing accommodation and supervision of the workers have been made, account for 44 of the 64 cases reported. These works employ the largest number of workers, and the high proportion in them is due to the closer supervision exercised by the management, resulting in the reference for treatment of all cases of warts found. For this reason also the cases reported from them are of slighter severity than from the others.

"The nature of the work is to grind material first to powder before compressing the pitch and fine coal dust into blocks. Improvements made to reduce the excessive dust have not been very successful. Great difficulty is experienced in maintaining the conveyor casings dust proof, and in addition it has to be borne in mind that the mixture of pitch and coal is of an explosive nature. The percentage of men using the baths is very small and is mostly confined to the younger men, who are not necessarily those most exposed to the dust. The percentage of men who change their clothing before going home is also very small. No really satisfactory preparation has yet been found for allaying the irritation of the dust on the skin. Dusting with starch powder or fuller's earth is used by some to relieve the burning and irritation on exposure to wind and sun, which is noticeable particularly after washing. In addition to the pitch warts, particulars were received of four cases of ulceration of the cornea due to pitch dust, involving in one case complete loss of sight. Crêpe or goggles are worn by some men but not universally.

"Incidence of the occupation of the men attacked was as follows: — Overmen 5, pitch discharging 8, pitch digging 1, wheeling 4, grinding 7, enginemen and firemen 5, pressmen 5, labourers 7, crane drivers 2, shippers 16, carpenters 3, and pitch winch boy 1. Of these, 15 were reported twice. Of the 64 cases, 17 were reported as severe, 19 as moderate, and 28 as slight. Severity depends on age and duration of employment. Thus, of the 64 men, 14 per cent. only were under 40, as compared with 80 per cent. of 40 years and over, but of the 36 cases which were marked as moderate or severe, only 8 per cent. were under 50. Of the 64 men, 12.5 per cent. only had worked under 10 years, and 87.5 per cent. for more than 10 years; indeed, 62.5 per cent. had worked for 20 years or more. Of those marked moderate or severe 7.5 per cent. only had worked under 10 years.

"The part of the body affected was the lip in 7 cases, the eyelid in 8, other parts of the face, head or neck in 22, scrotum in 18, hand and arm in 12, and other parts of the body in 1.

"The question of dilution in patent fuel works arose during the war, and although it was considered extremely unsuitable work for women, it had to be allowed to some extent. The three effects of pitch which had to be considered in this connection were (1) the stinging of the skin from exposure to wind and sun, (2) the formation of pimples and warts, and (3) the

occasional development of cancer. Seeing the long duration of employment before the epitheliomatous condition supervenes, there was no fear of the women contracting this. As regards the other two effects, the women, because of their more delicate skin, would probably suffer more than the men. The work they were limited to was trolleying, stacking, and light work, such as sweeping up.

"In addition to the epitheliomatous condition in pitch works, information was received of eight cases contracted either in tar works or by workers coming in contact with tar between 1914 and 1918. Four were reported as severe, suffering from epithelioma of the scrotum, two of which proved fatal, and one from epithelioma of the forearm, requiring amputation, in a man aged 60 engaged in net making and so handling tar.

"An exactly analogous malady arises in the refining of paraffin as carried on in the five shale oil works in Scotland. As a result of a conference held in 1918 with representatives of employers and workers, an agreement was arrived at, which Mr. H. J. Wilson (Northern Division), who acted as chairman, summarises as follows: —

"Workers in paraffin sheds to be provided with the protective clothing to wear above ordinary clothes.

"Spray baths to be provided for use of workers in paraffin sheds with hot and cold water laid on, soap and towels, locker for clothing and means of drying and washing working clothing. The bathrooms to be kept warm and clean and placed under charge of some responsible person.

"Workers in paraffin sheds to be medically examined quarterly by the certifying surgeon who will have power of suspension and control of first aid arrangements.

"An ambulance room with usual first aid appliances and, in addition, ointment for treating skin affections, and appliances for enabling persons to breathe outside air when in a poisonous atmosphere."

Miners' Nystagmus. Lancet, June 5, 1920, 198, No. 5049, 1224, 1230. — A writer in this number of the *Lancet*, referring to Dr. Stassen's book on "The Fatigue of the Visual Apparatus of Mine Workers" (La Fatigue de l'Appareil Visuel chez les Ouvriers Mineurs), says that it will rank with that of Dr. Lister Llewellyn among the chief authorities on miners' nystagmus. "As to the main cause of the disease," the writer continues, "the two are in entire agreement, and, indeed, the evidence is overwhelming that defective lighting of coal-mines is, in the main, responsible." Dr. Stassen says that the visual apparatus of the miner is overworked, owing to the length of time passed in partial darkness, and this overwork produces a nervous syndrome characterised by inco-ordination and exaggeration of the visual reflexes. Although the symptoms which precede or accompany nystagmus vary, they are all alike due to visual fatigue from work in defective light. The statistics and clinical observations which Dr. Stassen gives all tend to the same conclusion as to the causation of the disease.

The American Bureau of Mines has carried out some investigations on the same subject, and has published the results in the pamphlet by Frederick L. Hoffman on "Miners' Nystagmus" (Government Printing Office, 1916). These results are based almost entirely on information derived from European sources, from which is deduced the conclusion that a constrained position of the body, with the eyes directed upwards, is the chief source. This view is, of course, no longer held by English authorities who have investigated the matter of late years.

The British Journal of Ophthalmology (April, 1920) reports in full the recent discussion by the Illuminating Engineering Society (Eng.) upon the illumination of mines. Dr. Lister Llewellyn opened the discussion and devoted his attention chiefly to certain practical recommendations for the improvement of lighting in mines, with special reference to the causation of nystagmus by defective illumination. "A notable feature of the discussion," says the *Lancet*, "was that no one was found to defend the view that the cramped position of the miner at his work is mainly responsible for nystagmus; this is in contradiction to the teaching of Mr. F. L. Hoffman's pamphlet, issued by the American Bureau of Mines, but the American report has no basis of personal experience. Whatever factors other than deficiency of illumination may enter into the causation of nystagmus, it is amply proved that the most important is the amount of light reflected from the surface of the coal at which the miner is working." A British government inquiry is now being conducted into the question, and a joint inquiry by ophthalmic surgeons and engineers is also being organised. — W. E. Cossons.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Accident Prevention in Rubber Industry. *H. S. Poole.* Safety Engin., June, 1920, 39, No. 6, 305–308. — The main causes of accidents in a rubber mill may be broadly classified into four groups: fire, careless use of small tools, hazardous machinery, and vapor poisoning. Approximately 75 per cent. of the fires occur during the dry cold weather of January and February. This is mainly due to three causes: (1) Many of the processes require the use of naphtha and other inflammable solvents, which in a heated dry atmosphere evaporate more quickly than in a humid one; (2) fabrics and other combustible material are drier and more liable to ignite; (3) static electricity accumulates and builds up a considerable charge and potential in a heated dry atmosphere. Minor accidents due to use of small tools result mainly from careless handling, slipping, and carrying of sharp knives used in many operations. The rubber mills, calenders, tubing machines, punch presses, and pressure vulcanizers are the most hazardous machinery in a modern rubber plant.

In the compounding of certain rubber stocks, use is made of anilin oil, and the safe handling of this oil calls for extreme care on the part of the operator. This gas is poisonous in very small quantities when inhaled, and as it has a very pleasant odor and is not irritating, it does not give warning of its dangerous nature. The spilling of anilin oil on the hands, feet, and clothing may result in severe poisoning by absorption through the skin. It is also virulently poisonous when taken into the system through the stomach. Mills on which this oil is used should be provided with hoods connected with exhaust fans to carry off the gases. — R. M. Thomson.

Influence of the War on Accident Rates in the Iron and Steel Industry, 1914–1919. *Lucian W. Chaney.* U. S. Bur. Labor Statis., Month. Labor Rev., June, 1920, 10, No. 6, 151–163. — The author summarizes his article as follows:

"1. Whatever form of classification is used (the fundamental departments, production groups, or cause groups) the same trend is shown.

"2. The period just prior to the war was a period of industrial decline. Employment went down, 'labor mobility' almost ceased. Accident rates dropped more rapidly than employment.

"3. As soon as the effect of European war orders began to be felt in this country employment began to increase. The accession of inexperienced men increased even more rapidly. Accident rates went up.

"4. The iron and steel industry was alarmed by the increasing accident occurrence and undertook a strenuous counter-campaign.

"5. This was very successful in controlling and finally causing a decline in minor injury.

"6. Major injury was not controlled so perfectly but was prevented from rising above the level of 1913 and was finally considerably reduced.

"This review of the war period strongly supports the contention that even in the most strenuous times it is possible to hold in check the tendency to rising accident rates by the application of the three cardinal methods of the safety movement: (1) adequate instruction of the men in skillful methods of work; (2) careful supervision of the well-instructed men; (3) 'engineering revision,' by which the safety of work places is increased." — R. B. Crain.

INDUSTRIAL SURGERY

Standardized Surgical Methods in Industry. *C. D. Selby.* Mod. Med., May, 1920, 2, No. 5, 360–362. — This article, read during the annual meeting of the American Association of Industrial Physicians and Surgeons at New Orleans, April 26 and 27, 1920, was prepared for the purpose of suggesting lines of thought and for arousing discussion in a round table conference to determine whether standardized surgical methods in industry are desirable, if so, of what they shall consist, and what is the best means for securing their general adoption. Standards are presented for the treatment of fresh wounds, infected wounds, clean wounds, indolent wounds, and burns. A list of equipment and materials for minor wound treatment is offered for discussion, together with proposed means for securing adoption of standards. — M. C. Shorley.

Wound Infection in Industry. *Drury Hinton.* Mod. Med., June, 1920, 2, No. 6, 431. — The suggestions made in this paper are based upon the experience of Dr. George W. Crile. All wounds are potentially infected but heal promptly if made and kept surgically clean. With the efficient surgeon who is prepared for immediate action there is not the least excuse for infection. The results of the treatment as outlined in this article have been followed out in some 2400 cases at the Lakeside Hospital, Cleveland, Ohio, and there have been only three infections in the past year. All three were because the men failed promptly to report to the dispensary for treatment. Throughout the article special emphasis is laid upon the importance of prompt and immediate action. — L. A. Shaw.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Types of Fatigue. *Percy G. Stiles.* Am. Jour. Pub. Health, Aug., 1920, 10, No. 8, 653. — The author defines fatigue in general as depression of working capacity, owing to a katabolism running above the average for the tissue. Muscular fatigue, because of the large masses of active protoplasm involved, can extend its influence to other systems. In narrowly localized brain activity the metabolic process cannot be large and true cerebral fatigue is probably far less common than is supposed. The use of different cell-groups in rotation may minimize the demand upon each member. The ordinary cause of diminishing mental efficiency is the desire for a change. In a reasonably trained system this is a wholesome impulse. What we call nervous fatigue, referring to a condition which is pathological and often of long duration, is due primarily to lessened inhibition. Many of its features are symptomatic of bad habits established in the ill-controlled system. Unusual outflowing currents may pervert the action of the endocrine organs. Recovery from nervous fatigue is less a matter of correcting the metabolism than of desirable habit formation. — H. F. Smyth.

Monotony and Fatigue in Shop and Office. Mod. Med., June, 1920, 2, No. 6, 425–426. — The importance of psychological and physiological research in relation to industrial welfare is now recognized by the medical profession. The monotony of certain trades and industries is largely responsible for the ill health and discontent that prevail among the workers in these trades and industries. The human machine requires something more than good hygiene. The worker must perform his daily task in comfort and under circumstances in which sufficient variety exists to dispel or palliate the gloom of monotonous toil. It is with the object of studying these conditions that it has been proposed to found a British National Institute of Psychology and Physiology. The study will be made chiefly through the agency of well-equipped laboratories. Tests will be made in the laboratory for the purpose of establishing standards by which workers can be selected for work for which they are best fitted mentally and physically. Another function of the institute will be to provide training courses and lectures for investigators, managers, foremen, and welfare workers in the practical applications of psychology and physiology and to undertake investigations at factories and offices in relation to any special problems. Through the agency of such an institute, waste of time and the unnecessary fatigue which may be due to ignorance will become inexcusable. — L. A. Shaw.

The Speed of Adaptation of Output to Altered Hours of Work. *H. M. Vernon.* Industrial Fatigue Research Board, Report No. 6. His Majesty's Stationery Office, London, 1920, pp. 33. — The author summarizes this pamphlet as follows:

"When the hours of work are reduced, there is often no change in the hourly output for several weeks. Then it begins to mount slowly, but it takes a long time before it attains a steady value in equilibrium with the altered hours. The adaptation period was found to be about two months when the hours of tinplate millmen were reduced from 8 to 6 per shift, but thirteen months when those of open hearth steel melters were reduced from 12 to 8 per shift. In fuse operations it varied from two to four months, and in big shell operations from two months to six months or more. The time required cannot be predicted, but it is usually shorter in the simpler operations than in the more complex ones.

"When tinplate millmen were changed back

from 6-hour shifts to 8-hour shifts, their output fell without delay to approximately its equilibrium level; *i. e.*, there was little or none of the gradual adaptation observed in the reverse change of shifts. This evidence demonstrates the evil effect which intermittent periods of overtime must have on output.

"Fatigue in tool setters and laborers, or its removal, may have an outstanding effect on the output of the women under their charge; for when, at a 9.2 inch shell factory, the men's hours of work were reduced from $63\frac{1}{4}$ per week to 54 per week, whilst those of the women were increased from $44\frac{1}{4}$ to 54 per week, the women's hourly output at once began to increase rapidly, and in various operations it improved 10 to 42 per cent. on its previous value. The fatigue of the men was suggested by the fact that when they were working the long hours they lost 11.8 per cent. of their time, but during the shorter hours they lost only 6 per cent. of it.

"In the four shell operations investigated, the hourly output of the women, when on a $44\frac{1}{4}$-hour week, was 5 to 21 per cent. below that of the men when working under equal conditions, but on a $63\frac{1}{4}$-hour week.

"The amount of work (active and passive) done by women engaged on three shell operations was ascertained by careful inspection, and it was found that the women engaged on the heaviest operation lost 60 per cent. more time than those engaged on the lightest operation." — C. K. Drinker.

Strength Tests in Industry. *E. G. Martin.* U. S. Pub. Health Ser., Pub. Health Rep., Aug. 13, 1920, 35, No. 33, 1895–1926. — The author concludes with the following summary:

"1. Fields of usefulness for strength tests are seen in (*a*) physical classifications, to aid in selecting operatives for particular jobs; (*b*) as criteria of physical condition in connection with the relationship of physical condition to industrial efficiency; (*c*) as criteria of fatigue.

"2. The method of testing the strength of industrial workers is described in detail.

"3. Evidence is presented showing that with males laborious operations tend to develop approximately equal strength among the workers therein; in other words, there is a 'standard' strength for each job. A table of the strengths associated with the various operations studied is given.

"4. Male workers at very light operations are shown to have, in general, the average strength for adult males. A single group, made up of men with various disabilities and engaged in a very light sitting operation, had an average strength markedly less than the mean for healthy adult males.

"5. Evidence is offered that within individual groups of males the stronger workers are likely to be more efficient industrially than the weaker.

"6. The occurrence among male workers at laborious operations of individuals whose strength is much less than the standard for the job, and somewhat below the usual figure for healthy adult males, is assumed to be indicative of 'staleness' due to persistent over-exertion. Workers giving signs of 'staleness' show greater variations in the distribution of strength among the muscles in successive tests than do normally strong operatives.

"7. The question of the genuineness of poor strength showings is discussed and evidence given that it is more difficult to make deliberately an inferior test than to put forth full strength, and also that the variations in successive tests would necessarily be wider if the tests were fraudulent than are seen in the poor series here under examination.

"8. That physical condition, as indicated by the strength showing, tends to bear a definite relationship to the industrial efficiency as expressed in output is shown by comparisons of day-to-day records of various male workers.

"9. Observations are given showing that there is a definite tendency for the strength of all the male workers in a single environment to fluctuate similarly from day to day. The conclusion is drawn that external factors are operative in determining strength, and that these act on all the workers alike. Among these the temperature at which the work is carried on suggests itself as important. There is evidence that persistent exposure to temperatures above 30° C. (86° F.) is unfavorable to strength. Relative humidities between 70 and 80 per cent. appear to favor high strength showing. Other climatic influences have not been demonstrated to be operative. There is some suggestion that psychic influences, such as the arrival of pay day, may be operative. Since strength correlates with productiveness, the analysis of these external factors promises to be significant.

"10. In general, strong male workers show less fatigue than do weaker workers. This holds for workers regardless of the nature of their work and for the strong and weak groups within particular operations.

"11. Evidence is given indicating that the impairment of physique due to exhaustion may be so severe as to require considerable time of rest for recovery to normal strength.

"12. There is evidence that the effects of fatigue are persistent, in that they tend to appear on the day following a day of fatigue. Severe fatigue is more likely to show this persistent effect than is mild fatigue.

"13. Days of poor physical condition are more likely to be followed by days of fatigue than are days of good condition, or days on which no demonstrable fatigue appears.

"14. There is no evidence that the strain of night work in an eight-hour shift, changing every two weeks, impairs physique. A permanent night shift, working twelve hours nightly five nights in the week, averaged 15 per cent. lower in strength than the day shift doing precisely similar work; but the evidence is insufficient to decide whether or not this poorer showing was actually due to the night work.

"15. Women operatives show a gradation of strength corresponding with the laboriousness of their work; the actual strength showing is, however, regularly less than would be anticipated in manual workers.

"16. Women employed at tasks requiring mental alertness or close concentration make better strength showings than those engaged in routine manual toil, even though the latter be relatively heavy. A corresponding relationship is not apparent among male workers.

"17. There is evidence that among women, as among men, external factors influence the strength showing. The workers in a similar environment tend, as a group, to vary in the same direction from day to day.

"18. Among women, as among men, demonstrable fatigue is more manifest in weaker workers than in stronger. The most pronounced indications of fatigue are presented in an operation requiring close concentration and carried on in a disagreeable environment."—M. C. Shorley.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Safety and Medical Methods in Connection with Compressed Air Work. *Edward Levy.* Safety Engin., June, 1920, 39, No. 6, 293–298. — Certain changes in the laws relating to compressed air workers have been formulated at the suggestion of the New York State Department of Labor by representatives of compressed air workers, contractors, insurance companies, Industrial Commission, and the Public Service Commission. A short explanation is made of the physiological action that takes place in the human body when men work in compressed air, such as the nitrogen that is taken up in solution, partial pressure of carbon dioxide and the danger from carbon monoxide.

The new law requires that any contractor carrying on work in which men are permitted to work in compressed air shall employ a physician who shall have had experience in that particular line of work. Any person not having previously worked in compressed air shall not be permitted to work in a pressure exceeding 17 pounds without first having been tested by the physician in the medical lock, nor shall any such person be permitted to work under any pressure for longer periods than one-half a day period until he shall have been re-examined by the physician and found to be physically fit for such work. It is also a duty of the physician to keep complete records of the examinations made by him on a uniform blank and to note all answers to certain questions. The installation of a medical lock is not considered necessary until the pressure reaches 17 pounds or over.

The three important factors in the causation of compressed air illness are the height of the pressure in which men work, the length of time spent in air pressure, and the time and method of decompression. There seems to be no danger up to 22 pounds, and no serious cases have developed up to 29 pounds, but at this point, namely 29 pounds, the height of pressure is a factor, and becomes more important as the pressure is raised if the hours of labor are not properly adjusted. Suggestions as to the division of hours and the changes of shifts so as to make possible a full twenty-four hour schedule are included. The law strictly prohibits men from working more than two shifts in twenty-four hours. The method of decompression outlined is absolutely safe if adhered to.

One of the greatest safety factors is to have the men stay on the job for at least one hour after locking out. Sixty-four per cent. of all cases of illness, and the severe cases, as a rule develop within one hour after decompression, when most of the men are some distance away. — R. M. Thomson.

Death Caused by Less than 110 Voltage. *E. J. Riederer.* Safety Engin., July, 1920, 40, No. 1, 24. — This is a report of an accident which occurred in one of the Atlas Powder Company's works to an employee by an electric current (alternating) of less than 110 volts. The victim was disconnecting an electric fan that was connected to the line by an extension cord. The cotton gloves which he wore were soaking wet. When he took hold of the electric cord so as to unscrew the connection of the fan, he received an electric current which prevented him from doing his work, and also from letting go of the electric wires. He told another employee, who happened by, to shut off the current. While the latter was in the act of doing this, the left hand of the victim was brought to his chest directly under his heart, and the right side of his body was forced against some wet timber. When the current was shut off the man fell over, dead. All efforts to resuscitate the victim were of no avail.

"It is of vital importance to impress on all employees that any electric current may be dangerous, depending on circumstances or conditions, and that extreme care should always be used in handling electric equipment, no matter how high or low the voltage may be. It also brings out the importance of very careful inspection at frequent intervals of extension cords; also that they should be used only when absolutely necessary — and then only if they are in perfect order." — R. M. Thomson.

Reinforced Concrete from the Electro-Hygienic Standpoint. *Stephan Jellinek.* Wien. klin. Wchnschr., 1920, 33, 364–366. — Reinforced concrete offers a certain hazard in power plants and elsewhere if it has a low dielectric capacity. A short circuit may be established through the body of some worker touching a source of current. Frequent tests of the conductivity should be made to detect such a state in the material. — Barnett Cohen.

WOMEN AND CHILDREN IN INDUSTRY

The Performance of the Maternal Function by Women Engaged in Home Industries. *Carmagnano.* Reviewed from La Pediatria, No. 5, 1920, in Il Lavoro, May 31, 1920, 12, No. 1, 23–26. — Carmagnano discusses the performance of the maternal function by women engaged in home industries, their fecundity, how their children are fed, and what the physical condition of their children is. He draws his conclusions from a study of the histories in the records of the Pediatric Clinic of Turin of 331 women who were employed in home work, such as weaving, tailoring, various kinds of seamstress work, etc. In general, their hours were long, often extending far into the night, the pay was small, the housing insanitary, the food insufficient. For purposes of comparison the author then took the histories of 2800 housewives who visited the clinic, women of the working class but engaged only in their own housework, and of 117 peasant women. The differences between these three classes show strikingly the evils of tenement house industries.

	Women in Home Industries	Housewives	Peasant Women
Per cent. of abortions and stillborn	15.2	11.9	6.6
Grade of fecundity	2.7	3.4	4.0
Proportion of abortions to pregnancies	1 in 6.5	1 in 8.4	1 in 15.1
Mortality rate of children born alive	21.2	20.4	15.1
Per cent. of children suckled by mother	63.0	74.2	89.7

Since the housing conditions of the three groups were similar, the author concludes that the difference between the home workers and the other two groups lies in the exhausting work of the mother, preventing her from giving proper care to her babies and even from suckling them herself. — A. Hamilton.

A Sociological and Biological Study of the Effects of Student Life upon the Health of Women. *M. Hirsch.* Archiv für Frauenkunde und Eugenetik, April, 1920, 6, Nos. 1 and 2, 1–43. — This is an interesting study of the effects of the student life upon the health of women. The whole result of the author's statistics and questionnaires is to show that the student life is not menacing to the health of women. The time of sexual maturing is the danger time, but the investigations fail to show any deleterious effects that are general and due to study itself. It is only excess and over-exertion that are harmful. A question-

naire sent to academic women brought data showing that with advancing studies in all the departments from which the facts were gathered harmful results are less frequently reported, and improvement in health and beneficial effects of the academic and professional life are more frequently mentioned. The author concludes that there is no occupation that brings so little danger to health as the academic life. Even with medical women, whose profession makes large demands upon energy, improved health with continued work is indicated, and the percentages for harmful effects are about the same for various periods of the academic and professional career. Investigations of the relations between academic life and motherhood show, in the opinion of the author, that the diminished productivity in the class investigated is due to causes that can be traced to psychic and physiological factors rather than to failure in the reproductive powers. — G. E. Partridge.

On the Sickness Rate of Women Industrial Workers during the War. *Ettore Tedeschi.* Il Lavoro, May 31, 1920, 12, No. 1, 2–6. — In the present transition period from war to peace it is very important to examine the results of war time experience and decide what sort of personnel is best adapted to efficient and productive labor. During the war many thousands of women entered industrial life — a necessity at that time when the country needed every available man in the prosecution of the war — but the question now arises, have women shown themselves fitted to such work, is factory labor good for them and for the family?

The observations on which this article is based were made in a machine shop in which the women were doing lathe work. They showed a surprisingly rapid loss of health and strength. Women who had entered the shop in blooming health were soon pale, complaining of fatigue, headache, loss of appetite and lessened capacity for work. The physician in charge came to the conclusion that if such symptoms were neglected there was grave risk of tuberculosis developing, indeed a latent tuberculosis was probably present, but that if the women were made to take a vacation and were well cared for this might be avoided. The effect of this new kind of work was especially noted among the women on the night shift, although the actual strain of labor was lighter there, since supervision is never so strict at night. Two or three nights seemed to cause as much fatigue as a couple of weeks of day work. Women have proved themselves far less well adapted to industrial work than men and if they are to be retained in Italian factories there must be more medical supervision, shorter hours and no night work.

A distressing feature of machine shop work for women during the war was the effect of sperm oil, used as lubricant, which caused not only a dermatitis which was very obstinate and hard to treat, but also nausea, with loss of appetite. Here also women suffered more than men. — A. Hamilton.

In Favor of the Exclusion of Women from the Printing Trades. *Luigi Devoto.* Il Lavoro, May 31, 1920, 12, No. 1, 11–17. — Since 1910 Devoto has been an energetic opponent of the employment of women in the typographical trades and has twice, in 1908 at Lucerne and in 1910 in Lugano, tried to convince the International Association for Labor Legislation to declare itself against it. Both Congresses postponed the decision and the question came up again at the meeting of 1912 in Zurich, where Devoto and Carozzi, the latter of whom had made an exhaustive study of the printing industry in Italy, defended their thesis that the employment of women in so dangerous a lead trade as printing was detrimental to the race. They wished to exclude women from type founding — in Europe a branch of printing — from type finishing and from hand composition, linotype work, and stereotyping. They base their argument on the prevalence of tuberculosis among compositors — 20 per cent. of those that have come to the Milan clinic are tuberculous — and on the well-known fact that tuberculosis and lead poisoning go hand in hand. Only 150 women compositors have come under Carozzi's observation, but he states that they show an unusually poor physical condition compared to their condition prior to taking up this work. The printing trades have in general doubled the tuberculosis rate of other dusty trades in which the workers are not exposed to lead, and this is due not only to the presence of lead dust but to the fact that the industry attracts especially those boys who are delicately made and not strong enough for heavy occupations. Therefore women, who are more sensitive to the effects of lead, of dusts and of work requiring unphysiological postures, will suffer more than men

from the evils of the printing trade. There is no urgent need for women to enter such occupations and Devoto hopes that, for the good of the woman herself, for her children, and for the race, her participation in this trade will be prohibited. — A. Hamilton.

Hours and Conditions of Work for Women in Industry in Virginia. U. S. Dept. Labor, Women's Bur., Bull. No. 10, March, 1920, pp. 32. — A request from the governor of Virginia sent to the secretary of the U. S. Department of Labor resulted in a survey by the Women's Bureau of the Department of Labor of hours and conditions of work for women in industry in Virginia. The facts obtained through the survey include such as pertain to working hours, working conditions, and the administration of labor laws. An interview of fifty-nine women representative of the industries examined is also of interest. Facts thus obtained are used as the basis of recommendations for standards of work to be established either through specific laws or through legislation empowering the State Bureau of Labor and Industrial Statistics to regulate conditions of employment. — L. A. Shaw.

Child Labor and Vocational Training. *G. Loriga.* Il Lavoro, June 30, 1920, 12, No. 2, 44–51. — Loriga criticizes the Italian law under which children are allowed to enter industry at 12 years of age, to work eleven hours out of the twenty-four (which with the required rest periods means that the child spends thirteen hours inside the workshop), and the removal of all hygienic control from the working boy when he has reached 15 years of age. Thus an excessive strain is often put upon the youthful organism just at the time when rapid growth and pubescence are making a heavy demand on his strength. Nor is the boy's work always made lighter than the adult's on account of his age; on the contrary, he is often required to keep pace with a man and even to do extra work under compulsion of his stronger fellow-workers. As reforms, Loriga urges the postponement of entry into industry till after the completion of puberty, which, coming between 16 and 18 years, may conveniently be placed at 17 years; shortening the day to six or seven hours with rest periods; and insistence on proper sanitation of all workshops. In addition, vocational guidance and education are essential for the youthful worker. Scientific organization of industry is impossible so long as child workers are regarded simply as a part of the mechanism of production. — A. Hamilton.

INDUSTRIAL PSYCHOLOGY AND INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS

Twenty-Eighth Annual Meeting of the American Psychological Association. Jour. Educational Psychology, Jan., 1920, 11, No. 1. — At the twenty-eighth annual meeting of the American Psychological Association several papers were presented that are of interest to the industrial psychologist: *A Comparison of Motor Tests with Estimates of Character, Mental Test Scores, and University Grades; The Average Mental Age of Adults; What Industry Wants and Does not Want from Psychology; The Extension of Rating Scale Theory and Technique; Recent Development in Trade Test Theory; Changes in Some of our Conceptions and Practices of Personnel.* — G. E. Partridge.

The Use of Psychological and Trade Tests in a Scheme for the Vocational Training of Disabled Men. *R. S. Roberts.* Jour. Educational Psychology, Feb., 1920, 11, No. 2, 101–108. — Psychological and trade tests in vocational guidance may be divided, with some overlapping, into two groups: (1) tests to select persons for particular kinds of work; (2) tests to select a definite kind of work for the person to be trained. The first is comparatively simple, because, when there is a position to be filled, the employer has only to determine the degree to which each applicant possesses the necessary qualifications. The second problem is vastly more difficult. The problem of training men for positions where they can accomplish most for society and attain the greatest happiness for themselves is, however, highly important, and can be solved only by workers trained in ability to interpret mental processes. Intelligence tests, trade tests, and expert interviewing are the main methods to be used. — G. E. Partridge.

A Brief Group Scale of Intelligence for Use in School Surveys. *S. L. Pressey.*

Jour. Educational Psychology, Feb., 1920, 11, No. 2, 89–100. — The article is of interest as one of the large number of recent studies of intelligence. It offers suggestions for the simplification of mental tests. The tests given are four in number, each having twenty-five items, thus allowing numerical treatment on a scale of 0 to 100. The reliability of the scale is tested by the method of multiple correlation. — G. E. Partridge.

Personnel and Employment Organizations of Cosden and Company. Nat. Assn. Corporation Schools Bull., Aug., 1920, 7, No. 8, 351–356. — The article contains a useful table showing the functions of the employment department in accordance with the Federal Board for Vocational Education. It includes also a list of personnel activities as worked out by the employment department of Cosden and Company. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

A Survey of Personnel Activities of Member Companies. Nat. Assn. Corporation Schools Bull., Aug., 1920, 7, No. 8, 346–350. — One hundred and fifty-seven firms have contributed to this report. Returns in regard to various types of activity are summarized and presented numerically, showing the number of firms adopting each form. Job analysis is found in fifty-eight cases. Psychological tests are given by nineteen firms. Educational plans are very generally mentioned. Safety provisions, health activities, thrift plans, musical activities, and welfare provisions are found in great variety. Employment representation, on the other hand, is infrequently mentioned, and appears most often in the form of the welfare committee. — G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

Labor Legislation in Massachusetts, 1915 to 1919 Inclusive. Commonwealth of Massachusetts, Bur. Statis., Nov. 1, 1919. — The topics include: employment and unemployment, industrial safety, industrial sanitation, women and children, industrial education, Sunday labor and weekly days of rest, housing of working people, workmen's compensation and industrial insurance. — G. E. Partridge.

Court Decisions on Workmen's Compensation Law, June, 1918–December, 1919. New York State Dept. Labor, Special Bull. No. 97, Jan., 1920, pp. 278. — This bulletin, devoted to court decisions on workmen's compensation law from June, 1918–December, 1919, contains sections on the nature of accidents, hazardous employments, and other questions relating to compensation, and includes reports of cases. — G. E. Partridge.

Compulsory Health Insurance, State Medicine, or What? *Hugh Cabot.* Mod. Med., Aug., 1920, 2, No. 8, 533–538. — Among the defects which the writer points to as existing in the present tendency in compulsory health insurance are the following: (1) All members of the community are not benefited by such a system in that it usually applies only to industrial workers; (2) health insurance plans do not effectively provide for the prevention of disease; (3) there is evidence in existing plans that they promote second rate methods of practice; charge allowances are low, and consequently mediocre service is obtained; (4) a more serious objection is that the method of "pill peddling" is encouraged and frequent visits with inadequate equipment for full diagnosis tend to become a common practice; (5) the reaction upon the whole profession is unfortunate so that its ethics suffer.

The ill-defined term "state medicine" seems often to be intended to convey the idea that the state shall assume the responsibility for paying salaries of all physicians. The writer feels that such a plan has no reasonable basis, and that in general it is not taken seriously. He does feel, however, that the state is vitally responsible in many phases of medicine. Its interest in preventive medicine should be continued.

Following the idea in still another direction, the possibility of community participation in medical service presents many favorable aspects. Although industrial medicine has ac-

complished a great deal in recent years, it has certain disadvantages, such as the objection that it limits the right of choice of the individual. Any satisfactory scheme for a public medical service must be based upon the following requirements: (1) Every member of the community shall have satisfactory medical treatment "without requiring him to accept charity or go into debt"; (2) a reasonable freedom of choice must be allowed the individual as to the medical service which will be rendered him; (3) the cost of such service must be distributed so that it will not be a burden on anyone; (4) community medical service must not retard the development of the science and art of medicine.

The writer sees the possibility of the present community center offering a starting point for the development of community medicine. In its simplest form the community center provides a director of health whose chief duties are to co-ordinate existing activities, eliminate duplication, and promote efficiency. A step beyond this plan leads to the development of a staff of physicians whose activities will keep them thoroughly in touch with the community.

In following the idea still further, the community hospital becomes the point from which the activities of the health director will radiate. A scheme involving such an institution with its accompanying organization seems to imply a relatively small community or properly defined units of a large community. Such a hospital should be adequate to care for the average number of sick in the community and in surrounding districts dependent upon it. This hospital might well be under the control of a hospital board which would furnish its services without remuneration. As an adjunct to the work of a community hospital in a district where the population was considerably scattered, stations could be established which would be under the direction of physicians placed there by the hospital. Their work would be to furnish assistance and to direct the people to the facilities available at the central hospital.

The expense of such a scheme undoubtedly would be large. The writer suggests the possibility that many physicians would be willing to co-operate in such a community activity devoting only a portion of their time to the hospital work and the rest of it to private practice among those who did not care to avail themselves of community medical facilities. — C. H. Paull.

Compulsory Health Insurance. Il Lavoro, June 30, 1920, 12, No. 2, 54–60. — The law providing for compulsory health and old age insurance went into effect July 1, 1920. Briefly stated, its provisions are as follows: Insurance is compulsory for persons of both sexes between the ages of 15 and 65 who are employed for wages, and also for tenant farmers and *metayers*, *i. e.*, peasants working land on half shares. Those are exempt who belong to the wage-earning class but have an income over 350 lira a month, also tenant farmers and *metayers* when the income of one member of the family is over 3600 a year. Exceptions are made in favor of certain classes of insurance which were in force before the passage of the act. The insurance seems to be paid exclusively by the employer. All employers of labor by the day, or on contract, or by the job, also all contractors and subcontractors of public work, are obliged to insure their workers. Tenant farmers, although themselves insured under another section of the act, are responsible for insuring any who work for them except members of their families. No insurance is paid for illness lasting less than seven days, nor for illness during which full wages have been paid. The system of benefits is difficult to understand, but payments seem to be computed on the duration of illness and of military service — in the European war only — taken together, one lira being paid for each fortnight of illness and of service. In order to obtain sickness insurance a minimum of 120 fortnightly payments must have been made, for old age insurance, a minimum of 240. However, for the first period, 1920 to 1924, only twenty-four payments will be necessary for sickness insurance and those who on January 1, 1920 were between 55 and 65 years old may receive old age insurance after 120 payments. In case of the death of the insured before his right to a pension has matured, his widow or his children under 15 years of age receive 50 lira a month for six months. Voluntary insurance is allowed under the act for those not covered by its provisions. Insurance seems to be carried by two public bodies, by the Cassa Nazionale delle Assicurazioni Sociali and by thirty-seven provincial institutes recently created by the Ministry of Commerce and Labor. Representatives of insurers and insured have place on the administrative council of the Cassa and on the directories of the provincial institutes. — A. Hamilton.

REHABILITATION OF DISABLED EMPLOYEES

Rehabilitation for Industrial Cripples. *Irene S. Chubb.* Am. Labor Legis. Rev., June, 1920, 10, No. 2, 125–126. — This is a brief statement on the progress of rehabilitation legislation in various states. Up to 1920, ten states had taken steps to make rehabilitation a function of their compensation commissions. This year, New York and Virginia have taken steps to provide for the rehabilitation of cripples. In New York the industrial commission, the department of health, and the department of education co-operate in carrying out the intent of the rehabilitation law. Financial aid up to $10 per week, as well as schooling, is provided. Part of the funds for carrying on the work is derived from an assessment of $900 upon industries in each case of death where there is no person entitled to compensation.

State plans will in the future receive financial assistance from federal funds provided by the Fess-Kenyon bill. — C. H. Paull.

INDUSTRIAL MORTALITY AND MORBIDITY STATISTICS

Coal-Mine Fatalities in the United States in 1919 and Coal-Mine Statistics Supplementing Those Published in Bulletin 115. *Albert H. Fay.* (Including a list of permissible explosives, lamps and motors tested prior to January 31, 1920.) U. S. Bur. Mines, Bull. 196, Feb., 1920, pp. 86. — In addition to giving monthly fatality tables for 1919, this report includes several tables that were published in various monthly statements since 1914, thus making available in one publication all of the data compiled since that time. — M. C. Shorley.

The Mortality of Locomotive Engineers. *Hans Guradze* and *Wilhelm Sternberg.* Zentralbl. f. Gewerbehyg., Dec., 1919, 7, No. 12, 211–213. — Of 635 deaths during the period from 1913–1918, 19.68 per cent. of the deaths recorded were persons from 30 to 35 years of age; 16.38 per cent. were from 40 to 45. If the tabulation is arranged according to length of service, the fact appears that 18.45 per cent. died within ten to fifteen years. Only a few reached an age of service to which pensions were awarded. — M. D. Ring.

Causes of Death of Locomotive Engineers. *Hans Guradze* and *Wilhelm Sternberg.* Zentralbl. f. Gewerbehyg., March, 1920, 8, No. 3, 50–52. — This article is a summary of the causes of death of members of the Society of German Locomotive Engineers from 1913–1917.

Because of war enlistment, the largest number of deaths, namely 137, or 21.6 per cent., fall into the class of mortality due to outside agencies. Four out of these 137 cases were suicides. Heart disease caused 10.7 per cent. of the deaths; 10.5 per cent. resulted from pulmonary or laryngeal phthisis, a typical occupational disease of these workers; and 10.2 per cent. were the result of pneumonia. Only ten of the 635 cases recorded were listed as due to neurosis. Although this is a common malady among engineers, death usually results directly from other causes. — M. D. Ring.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

Volume II | DECEMBER, 1920 | Number 8

CONTENTS

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

RESPIRATORY SYSTEM

Report of a Case Showing the Relation between Occupation and a Certain Case of Bronchial Asthma. *Jacob Rosenbloom.* Am. Jour. Med. Sc., Sept., 1920, 160, 414. — The case is reported to show the relation of the occupation to the disease. The man, 44 years of age, had been a baker for twenty-six years but the duration of the asthma was only fourteen years. By skin tests he was shown to be sensitive to the proteins of rye and wheat with which he was working constantly. The author then quotes the cases reported by I. C. Walker in showing the relation of occupation to cases of true bronchial asthma developing in adults. Three methods of treatment are given: (1) Remove the offending protein; (2) change the protein by submitting it to high heat; and (3) desensitization by means of increasing amounts of the protein. — J. T. Wearn.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Composite Industrial Poisons: A Review. *William H. Rand.* U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1920, 10, No. 2, 176–197. — This article is a review of a series of papers by Dr. J. Mueller which were printed April to August, 1919, in the *Zentralblatt für Gewerbehygiene.* The author brings out the importance of combinations of substances used in industry as causative factors in industrial poisoning and cites Buergi who has shown that the variable effects of mixed poisons depend on several factors:

"1. Mixtures of two substances may yield a new chemical body.

"2. The solubility of one substance may be modified by the addition of another.

"3. The penetrability of the cell membranes by one substance may be affected by the addition of another.

"4. The cell becomes by saturation with one substance more or less absorptive of another."

A table is reprinted from one of Dr. Johann Mueller's articles in which are listed numerous industries and their peculiar processes in which workmen are subjected to the influence of multiple toxic agents. This list is most comprehensive and valuable.

A discussion of acetylene gas poisoning is

carefully developed and here again the effects of multiple poisons are described and personal case histories are related.

The importance of alcohol as an industrial poison may be regarded from three points of view:

1. The purely physico-chemical action: changes in surface tension of watery solution and solubility of fats.

2. Functional disturbances. By its paralyzing influence on all vital reactions, it reduces the normal resistance of the system.

3. Anatomical changes as a result of irreversible processes.

The reasons for the increase in the number of mixed industrial poisons are pointed out, as are also the difficulties in the recognition of mixed poisons. — L. Greenburg.

Recent Experiences on Industrial Poisoning. *Koelsch.* Abstracted as follows from Z. angew. Chem., 1920, 33, No. 1, 1–5, in Chem. Abstr., July 10, 1920, 14, No. 13, 2033–2034. — "A discussion of the general conditions resulting in poisoning is followed by an account of the symptoms and diagnosis of poisoning by alcohol, Pb, Hg, with its fulminate and chloride, As and AsH_3, oxides of Mn, mineral acids, nitrous fumes, CCl_4, tetrachlorethane, trichlorethylene, amyl acetate, HCN, cyanamide, C_6H_6 and its nitro derivatives, trinitrotoluene, tetranitromethane, trinitranisole, and amino derivatives of C_6H_6." — W. O. Fenn.

Poisoning by Arseniuretted Hydrogen. *T. H. Wignall.* Brit. Med. Jour., June 19, 1920, 1, No. 3103, 826. — The author mentions the fact that the textbooks do not give definite facts as to the minimal quantities of this gas capable of causing rapid death by toxemia, and then quotes Rambousek from Dr. Alice Hamilton's monograph, *Hygienic Control of the Aniline Dye Industry in Europe*, as authority for the statement that the hundredth part of a milligram of arsenic taken in the form of arseniuretted hydrogen is rapidly fatal for human beings. The gas is chiefly met with by the workers on processes in which nascent hydrogen is liberated or in which hydrogen is used as a gas — by lead burners or for the inflation of balloons; also where hydrogen is derived from the interaction of a metal with an acid or alkali. One or both may contain large amounts of arsenic and under these conditions the hydrogen may be contaminated by arseniuretted hydrogen. Certain reductions of the benzene derivatives also liberate the gas.

The signs and symptoms of poisoning with arseniuretted hydrogen are given and five cases are reported. From the amounts of arsenic in the urine of these patients during their stay in the hospital, and from the fact that all the cases recovered, the author concludes that a far greater amount of this gas may be taken by inhalation without causing death than has hitherto been believed. — J. T. Wearn.

Industrial Poisoning from Hydrogen Arsenide. *F. Koelsch.* Zentralbl. f. Gewerbehyg., July, 1920, 8, No. 7, 121–126. — Hydrogen arsenide (AsH_3) is a colorless gas with an odor like garlic. Industrial poisoning from this gas is usually caused by the action of an acid on a metal if one or both of them contain arsenic as an impurity. Traces of hydrogen arsenide may be found in all hydrogen gas used in industry unless it is produced by electrolysis. One hundred and sixteen cases of hydrogen arsenide poisoning are reported in the German literature and are traced to the chemical and metallurgical industry with 64 cases, laboratories with 14, making balloons with 22, and toy balloons, 16. To these Koelsch adds three hitherto unpublished cases from the chemical industry and eleven from a single metallurgical plant, in which vanadium iron is produced for the steel industry. The ore from southwest Germany (Monthranit) contains 6 per cent. vanadium, 30 per cent. lead, 9 per cent. copper, and 0.3 per cent. arsenic. It is leached out with sulphuric acid and for three years the process was carried on without any accidents, but suddenly, for some unknown cause, hydrogen arsenide was formed and, out of fifteen men employed in the room in which this process was carried out, eleven were poisoned, one fatally. No odor of garlic was perceived in the room — a phenomenon which has been noted before in cases where there was a strong concentration of the gas.

According to recent investigations by Joachimoglu, the fatal dose of hydrogen arsenide for man is about 0.1 to 0.15 gm. The concentration is, of course, of importance. Dubitzki says the danger begins when the air contains 0.05 parts per thousand and that 0.03 parts per thousand will produce poisoning after several hours. The symptoms in most of his cases came on some hours after the inhalation of the gas and in the lighter form they consisted only in headache

and nausea. More pronounced cases were characterized by exhaustion, dizziness, nausea, pressure in the epigastric region, vomiting, distention of the abdomen, diarrhea, and, after a couple of days, jaundice. Paresthesias and neuralgias were complained of in some cases. The urine for several days showed blood and bile coloring matters and the recovery was slow. The diagnosis of acute gastritis was made at first and only the number of men affected aroused the suspicion of a poison. This suspicion was strengthened by the appearance of the urine which was of clear dark red color and contained abundant albumin. A typical case was that of the industrial chemist who worked all day in the atmosphere of fumes and the next day awoke with a feeling of confusion, pains in the kidney region, was slightly jaundiced and had two attacks of unconsciousness during the day. The urine was like red wine and the color persisted for eight days. During the same time there was extreme weakness, especially in the legs, and rheumatoid pains in the arms and fingers. The autopsy findings in the fatal case were very characteristic: general icterus and icteric staining of all organs and fluids; enlargement of the spleen and of the liver, the latter showing slight fatty degeneration; gall bladder full of thick dark bile. Microscopic examination of the kidneys showed plugging of the convoluted and straight tubules with hemoglobin and fragments of red corpuscles. The circulating blood had undergone a slight degree of hemolysis.

Hydrogen arsenide poisoning must be differentiated from acute poisoning with the nitro and amido derivatives of benzene by the absence of methemoglobin formation and of cyanosis. Jaundice and blood in the urine point strongly to hydrogen arsenide poisoning; so do severe headache, tendency to fainting, and severe digestive disturbances with jaundice, even before blood appears in the urine. It is, according to Kobert, the only important industrial poisoning belonging to the hemolytic group. The treatment is based on efforts to restore the deficient oxygen by repeated administrations of oxygen inhalation kept up for days and sometimes weeks. Prevention means removal of the poisonous fumes or closed apparatus making their escape impossible. The fact that hydrogen arsenide colors mercuric chloride yellow makes it possible to detect small quantities of this gas by means of filter paper wet in mercuric chloride solution. — A. Hamilton.

Poisoning by Arsine. *M. Bannister.* Brit. Med. Jour., Sept. 25, 1920, 2, No. 3117, 470. — The author reports a fatal case of poisoning from the inhalation of arsine, produced during the manufacture of zinc chloride by treating in stone tanks "zinc ashes" and "flux skimmings," residues in the zinc galvanizing process, with commercial hydrochloric acid. As the gases are freely given off, the men are provided with masks and instructed to leave the tank as soon as the charge has been emptied into it. In the case reported, it was observed that the man did not go away from the tank after the gases began to come off, but remained at the side of it leaning upon his spade. He began to develop signs and symptoms of arsenic poisoning that evening and died four days later. A postmortem examination was made and the hair, liver, kidney and stomach were shown by chemical analysis to contain arsenic. On analyzing the materials used in the chemical process it was found that the commercial hydrochloric acid, the "zinc ashes" and the "flux skimmings" contained arsenic. The dangerous character of the gas is pointed out by the fact that the man apparently absorbed a fatal dose of the gas before he felt inconvenience from it.— J. T. Wearn.

Chronic Poisoning by Arsenic in Sweden. *Vittore Ravizza.* Abstracted from Giorn. chim. ind. ed applicata, 1920, 2, 189–190, by R. S. Posmontier in Chem. Abstr., Sept. 10, 1920, 14, No. 17, 2661. — "The general fear existing in Sweden of chronic poisoning by As has no serious foundation. The possible volatile As compounds (AsH_3 and others) occurring in rooms as exhalations of paints containing As are of a concentration 1/700 of that which would begin to cause any change in the blood, not necessarily poisoning. For one thing the employment of old analytical methods for determining As is responsible for the widespread fear. Results obtained by accurate analysis showed that in many cases two-thirds to one-sixth as much As was found as was indicated by the old official methods, and often no As was found at all where the official methods indicated it." — W. O. Fenn.

Industrial Poisoning by Fumes of Hydrocyanic Acid. *F. Koelsch.* Zentralbl. f. Gewerbehyg., May, 1920, 8, No. 5, 93–95; June, 1920, 8, No. 6, 101–105. — Hydrocyanic

acid is a colorless liquid with an odor of bitter almonds, boiling at 27° C. and therefore extraordinarily volatile. According to the literature, industrial poisoning from this compound and from other cyan compounds is extremely rare. Lehmann says that absorption takes place rapidly through the skin and that even the fumes may pass through the skin. Small quantities of hydrocyanic fumes are, therefore, produced when nitrogenous organic substances undergo incomplete combustion in illuminating gas, in smoke from burning celluloid, etc.; in the production and use of the ferro- and ferricyanides for colors, of the metallic cyanides in galvano-plating; in recovering and working with gold; and in removing the hair from skins by the use of residue from gas works. More serious exposure has occurred in the chemical industry and in the burning of large quantities of celluloid. Hydrocyanic acid was used for a while in gas warfare and endangered the men who produced and loaded it.

There is only one fatal case on record from the inhalation of hydrocyanic acid in the course of its preparation, but a similar case is reported in a woman who carried a jar of potassium cyanide solution down a flight of stairs and was fatally poisoned by inhaling the fumes.

Just recently hydrocyanic acid has come into extended use for the destruction of vermin. This use has existed in America since 1886, but in Germany only recently in order to get rid of lice and other insects. This innovation is of importance for the industrial hygienist because it endangers not only the persons engaged in disinfection, but also those who have to work in the disinfected premises. The usual method is to bring about evolution of hydrocyanic acid fumes with dilute sulphuric acid and sodium cyanide. The gas begins to come off immediately so that great precautions must be taken. The disinfectors are instructed to drop the package of sodium cyanide, paper and all, into the acid, and run. In a building of several stories the disinfection must begin on the top story and in the room farthest from the stairway. After the doors are closed they must be sealed and warning signs placed on the outside. The action of the gas is complete in two hours, but usually the building is left overnight. The doors and windows must be opened from the outside, and when this is impossible an oxygen helmet must be used. From half an hour to two hours' ventilation is long enough for the disappearance of the gas, but the apparatus in which it has been generated must be removed with great care, as was shown by the first fatal case of poisoning from this source in Germany, reported in 1917. Two men went in to carry out the receptacle in which the gas had been produced. As they lifted it, an unchanged portion of sodium cyanide was brought in contact with the acid and the fumes that developed poisoned the workman who was carrying the rear handles of the apparatus. He died in a short time. The second accident occurred in a lodging house for the Krupp workmen at Essen. Ten men who went into the disinfected rooms too soon were fatally poisoned, and five more were overcome but recovered.

The symptoms in these acute cases are — when the quantity inhaled is small — dizziness, choking, and dyspnea, irritation in nose and throat, injection of the conjunctiva, burning sensation on the tongue, loss of appetite, vomiting. There may be a sense of pressure in the frontal region and a sense of fear, which is a warning of oncoming loss of consciousness. Tintemann has reported nephritis lasting nine days, with albuminuria. Other sequelae are disturbances of circulation, rapid arythmic heart beat, general weakness, with dizziness, fainting, insomnia. A larger dose of the gas brings about sudden collapse with deep coma lasting for hours, convulsive twitchings, difficult, irregular breathing, pulse hardly perceptible, widely dilated pupils, death.

Chronic poisoning, the real industrial form, seems to be very rare. Apparently it has not been observed at all in a great gold and silver refinery in Frankfurt am Main, in which a weak solution of hydrocyanic acid has long been used. Very small quantities of this acid seem harmless, probably because it takes up sulphur in the body and is changed to the non-toxic sulphocyanogen. A few cases of subacute or chronic poisoning have been described. Chanet described cases among workers in a galvanizing factory where the air smelled strongly of bitter almonds, and Merzbach found such a case in silver plating. The man had breathed very small quantities of hydrocyanic acid for thirteen years. Koelsch has himself been unable to discover any disturbance of health in the factories he has visited. According to those who have described chronic cases of poisoning, the symptoms consist in headache, roaring in the ears, dizziness, a feeling of weakness, burning in the throat, dyspnea, and palpitation of the heart. Animal experi-

ments seem to show that it is impossible to bring about tolerance to the gas.

Koelsch has observed among men employed over galvanizing tubs an affection of the skin of the face, which is apparently typical acne rosacea, and he attributes it to an irritation of the vasomotor nerves of the face, resulting in an angioneurotic inflammation like that produced by alcohol. The pathology of hydrocyanic acid is essentially an "internal suffocation" brought about by the formation of cyanhemoglobin, the interference with normal oxygen supply to the body cells, and a simultaneous paralysis of the central nervous system, especially of the center of respiration. The effect is apparently cumulative. The poison is partly excreted unchanged through the lungs and sweat, and traces are found in the urine. According to Lehmann's experiments, hydrocyanic acid is fatal in one-half to one hour when present in the proportion of 0.3 to 0.12 mg. in a liter of air.

Koelsch has tested with Schönbein's reagent the air over galvanizing tubs and has obtained positive results, as also from the fine dust on the floor and other surfaces. Nevertheless, in those very places there was no evidence of harm resulting from the presence of the gas which was probably well under 0.02 mg. per liter. Such quantities, he believes, are negligible. He concludes with a consideration of the regulations recently passed in Germany to prevent accidents from the use of this gas as a disinfectant. The German government has given the control of this procedure to the German Society for the Prevention of Accidents. As to the treatment of severe poisoning from hydrocyanic acid, he advises inhalation of oxygen with artificial respiration, injection of suprarenin and perhaps atropin, and washing out the stomach with hydrogen peroxide. In order to help nature to bring about the change to the harmless sulphur compound, it may be well to inject subcutaneously a 5 per cent. solution of sodium thiosulphate. The prognosis is good after the first hour, for the man who does not die in the first hour is likely to live. — A. Hamilton.

Harmful Effects of Blast Furnace Gas. *Derdack*. Zentralbl. f. Gewerbehyg., May, 1920, 8, No. 5, 90. — In a large smelter in the Saar basin, a number of accidents have recently happened which were traced to the breathing of purified blast furnace gases, and which were characterized by very peculiar symptoms. The men lost consciousness but were revived by the administration of oxygen. They gradually recovered their general health but a permanent mental impairment remained, which eventually led to their removal to the insane asylum. Several months have elapsed since then without any improvement in their mental condition. According to the management of the smelter, accidents of this sort never occurred until dry purification of the blast furnace gas was introduced in place of the former washing. Therefore, they believe that the dry method of purification must result in the presence of certain poisonous gases which were not formed in the course of washing — perhaps arsenical or cyanogen compounds. — A. Hamilton.

Observations on the Toxicity of Coal Tar Dyes in Industry. *Bachfeld*. Zentralbl. f. Gewerbehyg., July, 1920, 8, No. 7, 113–121; Aug., 1920, 8, No. 8, 149–158. — Bachfeld considers only the toxic effect of coal tar colors on the men manufacturing them, and discusses two possible effects — diseases of the skin, and inflammation of the eye following the entrance of a foreign particle. He bases his conclusions on a six-year experience as industrial physician in a color factory in Offenbach. During these six years there were 159 cases of skin disease, thirty-two of them resulting in disability and loss of time. The number of men exposed was 4945. In order to discover whether their occupation had anything to do with the skin lesions, he grouped the employees into those who handled crudes and intermediates, the color makers, the men handling finished colors, and those exposed to neither colors nor intermediates. The proportion of skin lesions was highest in the color makers, with 3 to 4 per cent.; next in the department of crudes and intermediates, with 2 to 3 per cent.; then the finished colors, less than 1 per cent.; and finally, the fourth group, with 0.28 per cent.

Weyl has classed ninety-six coal tar colors as poisonous. These belong to the following classes: nitro colors, triphenyl and diphenylmethane colors, acridin, oxazin, and thiobenzyl colors. Twenty-four of these are produced in the Offenbach factory but none has shown itself to be toxic. Only two cases of skin disease could be clearly connected with the handling of colors; one, with sulphur black, and the other, with *Echtmarineblau*.

That the finished colors are harmless has been shown repeatedly by practical experience in this factory. Workmen who cannot stand exposure to the crudes and intermediates, who complain of headache and loss of appetite, and are anemic and weak, are transferred to the color department as a routine practice. Indeed, their experience is that the farther the process is from the crude stage, the less the toxicity of the product. The addition of acid and methyl radicles lessens toxicity greatly. Martius yellow or Manchester yellow, which is dinitronaphthol, is poisonous, but the calcium or sodium or ammonium salt of dinitronaphtholsulphonic acid is non-toxic. Metanil yellow and Orange II are exceptions to this rule, for in spite of the entrance of a sulpho group they are distinctly toxic.

Bachfeld has seen eczema and irritation of the mucous membrane caused by New Blue R or *Echtmarineblau*. The powder only is irritating, not the solution. Cases of skin disease that arose in the azo color department he attributes to the benzidin and tolidin, rather than to the colors. Seven cases in the fuchsin department were probably due more to the purification agents than to the finished color. The production of methyl violet gave some trouble and in the alizarin department there were six cases of skin disease, but none of them could be traced to the colors themselves. An individual idiosyncrasy had evidently much to do with all of these cases, for a great majority of the workmen remained unaffected by the irritating compounds.

As to the effect on the eye, the question was whether a bit of color dust acted in any way differently from an inert foreign body. It was evident from the records that the department of finished colors had the greatest proportion of eye accidents resulting in disability. Forty-three cases were reported from this department and the colors responsible were triphenylmethane dyes and one oxazin dye. Methyl violet and methyl green were responsible for the greatest number of cases — a fact which is explained by the dust-producing methods in use in this department. There was no evidence that the injury done by the color dust was any greater than that produced by inert foreign bodies in other departments. Bachfeld is unable to explain the unfavorable experience of other physicians, such as Wagenmann in Graefe's Handbook of Ophthalmology, unless it be that the workmen, frightened by the strange look of the dye on the eyeball, used such energetic and inappropriate methods to get rid of it as to infect their eyes. — A. Hamilton.

Recognition and Treatment of Tumors of the Bladder in Aniline Workers. *Rudolph Oppenheimer*. Zentralbl. f. Gewerbehyg., June, 1920, 8, No. 6, 105–107. — Success in treating aniline tumors is dependent on their early recognition, therefore routine examination of the urine in suspected cases is highly important. The urine should be voided in two portions, and the second half examined for red blood cells, for their presence, although not a specific sign of bladder tumor, is very common in the early stages and may appear before the cystoscope reveals the tumor. If the cases are discovered early, it is often possible to keep the men for years in good health and to prevent the change of a benign tumor to a malignant form. In case of malignancy the bladder must be opened and the tumor removed. But non-malignant growths favorably situated and not too large are better handled by electrode or snare, which after repeated applications results in the removal of the tumor without surgical interference. Six cases of this sort were operated on in this way by Oppenheimer and five are still at work. The sixth had to be operated on two years later for a cancerous growth. — A. Hamilton.

Industrial Blood Poisons. *C. R. Newton*. Jour. Am. Med. Assn., April 24, 1920, 74, No. 17, 1149–1150. — The writer reports very briefly upon the blood picture in three cases of benzene poisoning, one of benzene-aniline mixed poisoning, and three of aniline poisoning, which he had the opportunity to study during the war. He also made observations upon ten subjects exposed to the possibility of benzene poisoning for periods varying from one week to five and a half years to determine whether there was any cumulative effect. His conclusions are as follows:

"1. Workers chronically exposed to benzene may show leukopenia without any other symptoms, and make complete recovery.

"2. Acute exposure to anilin and nitrobenzene vapors produced cyanosis with destruction of the red blood corpuscles, but with little change in the white corpuscles, with recovery. In one case in which free benzene was presumably present, there was destruction of white

cells without appreciable destruction of red cells, and a more rapid recovery, that is, in three days.

"3. The maximum white cell destruction by benzene, and the maximum red cell destruction by anilin-nitrobenzene, may not be reached for several hours after the onset of the symptoms.

"4. Workers exposed for long periods to benzene may not have a leukopenia; apparently, therefore, the action is not cumulative." — C. K. Drinker.

The Fate of Beta-Naphthylamine in the Organism of the Dog. *Engel.* Zentralbl. f. Gewerbehyg., May, 1920, 8, No. 5, 81–86. — The author is attached to the great dye works at Ludwigshafen. He discusses the etiology of tumors of the bladder in aniline workers and refers to the communication made before the Congress of Industrial Physicians in 1913, which emphasized the importance of studying those compounds apparently responsible for this industrial disease. Leuenberger at that time expressed the view that the amido compounds, which are probably the causative agents, undergo hydrolysis (introduction of the HO radicle into the ring) in the organism and that it would be well to find out whether it is possible to group the amido compounds according to the form in which they are eliminated and see whether these findings can be brought into any agreement with the clinical and industrial history of the actual cases. Leuenberger believed that the localization of the tumors in the bladder pointed to the action of some elimination product and that, in all probability, the product was an hydroxyl derivative of an amido compound. Engel remarks, however, that there are some striking exceptions to this statement. Thus, diphenylamine undergoes complete loss of its amido group, while two even more important compounds, paratoluidin and alpha-naphthylamine, are excreted unchanged. The same is true to a certain extent of aniline. We must reckon, therefore, with the possibility that we have to do not only with typical hydroxyl elimination products but also with other intermediates or perhaps with the unchanged amido compounds themselves.

Engel selected beta-naphthylamine for his experiments because a conspicuously large number of cases of bladder tumor have arisen in connection with the handling of this substance — a fact which is all the more surprising because there is nothing about its production or use which renders work with this compound unusually hazardous nor is it particularly volatile. Engel undertook to determine whether beta-naphthylamine undergoes hydrolysis and whether there is also the formation of such bodies as amido naphthol or amido dioxynaphthaline and finally, whether these latter undergo before elimination conjugation with ether sulphuric acid or glycuronic acid. He selected dogs as his subjects, made preliminary estimates of the ether sulphuric acid and glycuronic acid excreted in twenty-four hours, then administered the beta-naphthylamine subcutaneously. The result was a marked increase in the excretion of ether sulphuric acid and a less marked increase in glycuronic acid, the increase persisting for five or six days. If the dogs were kept on a carbohydrate diet the greater part of the beta-naphthylamine underwent conjugation with the glycuronic acid; on a flesh diet, with the ether sulphuric. The experiments are being continued in order to determine the properties of the decomposition products of beta-naphthylamine in the urine, and similar experiments are also being conducted with alpha-naphthylamine and dimethylaniline. — A. Hamilton.

Recommendations Concerning the Manufacture and Use of Wood Alcohol. U. S. Bur. Labor Statis., Month. Labor Rev., Feb., 1920, 10, No. 2, 197–201. — A brief discussion of the uses and physiological effects of wood alcohol is followed by the regulations suggested by the National Committee for the Prevention of Blindness for the uniform control of the use of wood alcohol. — L. Greenburg.

Lead Poisoning and its Prevention. *C. P. Tolman.* Abstracted as follows from Proc. Nat. Safety Council, Eighth Ann. Safety Congress, 1919, 448–458, by C. E. Curran in Chem. Abstr., July 20, 1920, 14, No. 14, 2219. — "Methods and devices used in prevention of dust hazards in manufacture of white and red Pb, etc." — W. O. Fenn.

DUST HAZARDS AND THEIR EFFECTS

The Separation of Dust from the Waste Gases of Ovens for the Recovery of Copper from Old Brass. *Tittler.* Zentralbl. f. Gewerbehyg., July, 1920, 8, No. 7, 126–130. — During the war, because of the scarcity of copper, a large amount of old brass was smelted and reduced to black copper. In this process zinc, as zinc oxide and also in vaporous form as metallic zinc, is liberated into the waste gases of the ovens. The vaporous metallic zinc is precipitated as metallic zinc dust as the gas cools, unless it is changed to zinc oxide, and in any case the gases contain quantities of zinc oxide dust, vitiating the air in the vicinity of the works. Most of the plants which have been doing the work of reducing old brass have lacked equipment for separating out the dust, and since many of these plants have been situated in thickly settled districts much trouble has been caused. Means of separating the dust have long been known in smelting circles, however, although they have been developed rather for economic than for sanitary reasons, since the dust has commercial value. Schabel in 1890 showed the necessity of rendering the smelting dust harmless, and since then the technique has been worked out and is now well advanced.

The writer of the present paper has had occasion to make observation of the methods in actual use in a large number of plants which are doing brass smelting. He describes the furnaces that are employed, and gives in some detail an account of processes for still further separating the metallic materials. The gases are conducted through iron pipe systems which are cooled either by air or water. He finds in operation also a process of continuing the purification of the gases by means of filters — a process which is described in detail, including some of the difficulties met in the operation. A centrifugal method is also mentioned. Another method is the separation of the metallic particles by means of the electric current. Experiments were made with this method a good many years ago, both in England and in Germany, and it is said that the system devised by Cottrell is in successful operation in Freiburg.

As a conclusion from all the investigations, the writer asserts that the purification of the gases from the processes under consideration is absolutely necessary. The commonly employed methods of cooling and condensation are not adequate; there must be actual purification of the gases, and this is best accomplished by filtering. Several processes are still in an experimental stage and definite judgments cannot be passed on them. — G. E. Partridge.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Prevention of Accidents on the English Railways. *Wernekke.* Zentralbl. f. Gewerbehyg., May, 1920, 8, No. 5, 90–93. — The excessive accident rate on American and English railways has given rise in recent years to a definite movement in these countries, first in America, then in England, to prevent such accidents. These efforts are well expressed by the phrases that have been adopted as the watchwords of the movement — "Safety First!" in America, and "Is It Safe?" in England. From these the writer thinks Germany has nothing to learn, although efforts abroad in fields in which the Germans are pioneers and have made the greatest advances, are interesting to observe. He relates the history of the movement that began in England in a measure adopted in 1871, and presents a statistical table showing the number of railway accidents on English roads for the years 1900 to 1915. The figures for the Great Western Road are given for the period from 1910 to 1918, showing that its method of suggestion and reminders to its employees has been relatively successful. Up to 1913, when the campaign against accidents was initiated, the rate had greatly increased; after 1913, there was a marked and continuous decrease. — G. E. Partridge.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II — JANUARY, 1921 — NUMBER 9

CONTENTS

GENERAL

REPORT OF THE NEW JERSEY DEPARTMENT OF LABOR, JULY 1, 1918–JUNE 30, 1919. Pp. 164. — Among the subjects of interest to the industrial hygienist contained in this report is the complete text of a code of safety standards relating to the use and care of abrasive wheels, prepared by the New Jersey Bureau of Electrical and Mechanical Equipment in conjunction with the joint Safety Committee of the Abrasive Wheels Manufacturers of the United States and Canada and the National Machine Tool Builders' Association.

The report of the Bureau of Hygiene and Sanitation of the Department of Labor emphasizes the importance of proper first-aid and hospital equipment in manufacturing establishments, and illustrates by a number of letters from New Jersey manufacturers the practical working experience of plants where first aid is practiced.

During 1919 the United States Public Health Service conducted a sanitary survey of the pottery industry in New Jersey to determine the risk to health in this industry resulting from the use of lead glazes. A full outline of the purposes and scope of the survey, the processes covered and the method of making the survey is given in this report. The findings of the survey are not given.

Pages 90–92 of the report contain the revised New Jersey standards for the installation of toilet equipment and enclosures in industrial establishments.

A second set of standards contained in the Department of Labor report and of interest to industrial hygienists are the standards for brass and bronze foundries and metal-finishing processes. These standards represent a careful survey of the brass industry in several states and are based on safe practices under which the better type of brass and bronze foundries are conducted.

"During the year ending June 30, 1919, the Industrial Accident Bureau received 31,251 re-

ports of tabulatable accidents, viz., accidents arising out of the employment and resulting in death, permanent disability or in the loss of time in excess of the remainder of the day, turn or shift on which the injury was incurred. There were received in addition to the above number, upwards of 20,000 reports showing only minor injuries and involving no actual loss of time.

"Of the total of 523 fatal and 30,728 non-fatal accidents reported as having occurred to workmen engaged in the four occupational groups into which the compilation is divided, 350 fatal and 17,304 non-fatal accidents are charged to factories and workshops, 57 fatal and 7,084 non-fatal to building and construction, 17 fatal and 205 non-fatal to mines and quarries and 99 fatal and 6,135 non-fatal cases to the miscellaneous group.

". . . Only 54 or 15.4 per cent. of the fatal accidents and 4,907 or 28.3 per cent. of the non-fatal accidents were attributable to mechanical power, and of this number power working machines were responsible for 8 fatal and 3,019 non-fatal accidents. This analysis does not warrant the general inclination to associate industrial hazard almost exclusively with mechanical causes.

"Explosions of powder and dynamite, with 120 fatalities, 76 of which resulted from" one explosion, "were the greatest single cause of fatal accidents, closely followed by falls of persons with a total of 35, sixteen of which were due to falls from scaffolds, ladders, etc.; cranes with a total of 30 and hot substances, fire, chemicals, etc., with a total of 25 fatalities.

"Handling objects accountable for 3,025 or 17.48 per cent., power working machines with a total of 3,019 or 17.45 per cent. and falling objects not being handled with a total of 2,580 or 14.91 per cent. were the causes of the greatest number of the non-fatal accidents.

". . . Of the total number of accidents, fatal and non-fatal, in all industries, 26.42 per cent. occurred in metal working, 23.03 per cent. in shipbuilding and woodworking, 12.83 per cent. in chemicals and 10.63 per cent. in machinery industries.

"The necessity of having all injuries, no matter how apparently slight, reported and treated immediately, is evident from" a "table which shows that there were 1,738 cases of infection following injuries. Six of these cases resulted fatally and three caused the loss of a finger.

"Injuries to the eye resulted in 9.91 per cent. of the non-fatal accidents in factories and workshops.

"The Industrial Accident Bureau has continued the issuing of monthly bulletins in which the accidents of the previous month are analyzed as to their causes, results and the industries in which they occur. In addition to our accident statistics bringing to the attention of our safety engineers and factory inspectors the risk hazards of industry, they have become a very interesting and valuable source of information to the members of the Rehabilitation Commission in their study of economic consequences of permanent injuries suffered by industrial workers in the state."

The Division of Industrial Information of the Bureau of Industrial Statistics is establishing an industrial safety museum which will serve as a clearing house for the standardization of environment factors in productive industry. The "especial object of this Industrial Safety Museum is to provide facilities for the employers of the state, in their efforts to learn of the most practical methods used by their industrial competitors in reducing the labor turnover and stabilizing industrial relations.

"The department believes that — basic questions of wages and hours aside — a large percentage of unrest and inefficiency in the factory is due to working handicaps. It has, therefore, for the past five years, been gathering data throughout the country concerning successful production standards in our leading industries. At the museum it will handle all phases of the stabilizing of the labor force, covering the following divisions by means of physical exhibits, machinery, charts, blue prints, and photographs:" (1) accident prevention; (2) first aid; (3) fire hazards; (4) steam boiler hazards; (5) lighting standards; (6) hygiene and sanitation, exhaust ventilation; (7) lunch rooms; (8) structural exhibits; (9) industrial relations including (a) housing, (b) insurance, (c) shop committees, and (d) labor turnover and employment methods; (10) woman and child labor problems; (11) industrial training; (12) library service; and (13) exhibits of production standards. — K. R. Drinker.

Industrial Health Education—A Means and an End. *J. Schevitz.* Am. Jour. Pub. Health, Oct., 1920, 10, No. 10, 780–782. — "If health officers were backed in their work by business men they would no longer worry about inadequate appropriations or political inter-

ference. Business men already know the economy of health in the factory. It is the duty of industrial hygienists to furnish the missing link and educate the business man to the value of bettered public health to his factory and himself." — H. F. Smyth.

A National Institute of Industrial Physiology. Abstracted as follows from Lancet, April 13, 1920, 1, pp. 779–780, by W.D.H. in Physiol. Abstr., Aug., 1920, 5, No. 5, 213. — "In the current number of the *Times Engineering Supplement* a detailed account is given of the proposed National Institute of Psychology and Physiology applied to industry and commerce. . . . The intention of the founders is to establish a national institute which will investigate the human problems of industry and commerce, occupying a position similar to that held in the domain of physical science by the National Physical Laboratory." — McKeen Cattell.

Report of the Committee on Occupational Diseases in the Chemical Trades. *C. Baskerville et al.* Abstracted as follows from Jour. Indust. and Engin. Chem., 1920, 12, pp. 439–440, by L. W. Riggs in Chem. Abstr., July 20, 1920, 14, No. 14, 2230. — "Specifications for goggles for various purposes may be had, on application, from the Bureau of Standards. Immunity from influenza of workers in bromine plants was observed among large producers, while data leading to the opposite conclusion was reported by small producers and users. Reports indicated that people working in the manufacture of illuminating gas, cordite, tin, poison gas, NO_2, SO_2 were much less (one-fifth to one-twenty-fifth) likely to contract influenza. Liberal and deep applications of lanolin to the interior of the nose protects the membrane from infection which causes colds. More research and publicity of an educational nature with reference to industrial hygiene is recommended." — W. O. Fenn.

Why were Half of Our Young Men not Fit for the Fighting Line. *G. R. Cruikshank.* Pub. Health Jour., Aug., 1920, 11, No. 8, 353–355. — The following are points of special interest from Mr. Cruikshank's analysis of 1000 consecutive cases examined for the military draft in an agricultural and sawmill county: Out of 1000, 436 were placed in classes other than A; 75 were rejected on account of defective feet; there were 33 cases of Graves' disease and 7 of simple goitre; probably 6 per cent. of the young men of the county suffered from rheumatic fever; 46 were excluded for tuberculosis; there were 21 cases of general debility; 6 per thousand were excluded for syphilis and 3 per cent. for gonorrhea — this does not however indicate the incidence of these diseases as where there was hope of a quick recovery rejection was not thought necessary. — R. M. Hutton.

Efficiency of Mine Labor as Related to Industrial Medicine. *A. L. Murray.* Mod. Med., Sept., 1920, 2, No. 9, 606–608. — Labor efficiency depends upon many and varied factors, such as proper selection and placement of man power, medical supervision, proper living conditions, the social and moral tone of the community. In the selection of men, there are two main requirements to be kept in mind — physical ability and adaptability. Every man employed by a mining company should be examined physically before being employed, and the information thus gained should be used in the assigning of men to positions. Records kept of such pre-employment examinations by firms employing large numbers of men show that the rejection rate is very low. The reports of one large corporation show that on first examination 7 per cent. were found physically unfit, and that by simple operations and corrective measures three-quarters of the rejected group could finally be employed.

The successful operation of a mine depends as much on supervision of its men as upon the care of its machines and, as a means of increasing efficiency, industrial medicine must be regarded as of prime importance. The waste from preventable disease is at present very great. Popular education in hygiene and similar subjects can be given in mining communities through agencies that may readily be provided. Visiting nurses can give instructions; short talks on health subjects should be given at regular intervals, illustrated, when possible, by lantern slides, motion pictures or charts; first-aid classes should be organized, not only among the men, but among the women and older children of the camp. Clean-up campaigns, anti-fly campaigns, and the like are useful. The medical and surgical care must be the best possible, and especial attention should be paid to slight ailments and injuries. Where practicable a hospital, or at least an emergency room, should be maintained at the mine. At

large mines a safety engineer is as important as a mining engineer. Drinking fountains and sanitary latrines under ground are recognized as necessities, and change houses ought to be provided where the men can bathe and put on clean and dry clothing before going home. Health provisions do not end here, however, but must extend to housing, supervision of boarding places, the perfecting of water supply and sewage systems and the provision of facilities for recreational and social life. — G. E. Partridge.

Social Hygiene in the United States. *P. Popenoe.* Ztschr. f. Sexualwissenschaft, April, 1920, 7, No. 1, 22–31; May, 1920, 7, No. 2, 60–63. — The writer asserts that during the past ten years the whole face of the problem of social hygiene in the United States has changed, and especially since our entrance into the war. One of the greatest factors in our advancement in social hygiene has been the increased control of such evils as prostitution and venereal diseases, an improvement made possible by military authority. The plan by which prostitution is regulated under medical inspection has not proved successful and there are, in fact, many objections to it. One of them is that, because of the nature of the medical work involved, incompetent and irregular practice is possible and hardly to be avoided, and the thoroughly trained man has not been eager to enter the field. Investigations show that there is more disease among the regulated than among the unregulated prostitutes, and the difficulty of segregating the class has been great. Such objections have led to the American plan, the essential feature of which is the belief that suppression is the only cure. There has been an awakening to the gravity of the evils, and a strong effort is being made to stamp out prostitution as the cause of disease. The American plan has the support not only of federal and state authorities but of public opinion as well. The present status of prostitution, in its legal aspects, in the various states of the Union is defined, and the paper contains other useful data. The work of the United States Interdepartmental Social Hygiene Board, of the United States Public Health Service, and of the American Social Hygiene Association is described. The measures taken during the war — prophylactic and other — are mentioned, and the statement is made that the method of prophylaxis has not been so successful in preventing disease as a civilian measure as it has been as a military measure. These problems, we must understand, although they have been focal in the past few years, are only a part and, in a certain sense, a small part of the whole problem of social hygiene. The chief purpose of social hygiene, from the American viewpoint, is the securing of the family as a social unit in such a way as to advance mankind in every possible direction. To that end we must have in mind all the conditions favorable and unfavorable that enter as factors into this problem of the family. Some of these are biological, some are ethical.

In the second part of the paper the American plan for the handling of the problems in question is presented somewhat in the form of an ideal. There are four lines of attack: by legal pressure; by enlightenment and education; by medical measures; and through diversion by recreational means and the like. — G. E. Partridge.

Continuation Classes in England. School and Society, Sept. 18, 1920, 12, No. 299, 233. — Much excellent educational work has already been done in the continuation classes that have been formed under the Educational Act of 1918. Schools have been established providing for seven or eight hours of study each week, and some in which employees attend classes from two to three hours each day. In some cases vocational training is included. In one city fifteen firms have combined to establish a school. — G. E. Partridge.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Temporary Blindness, with Paralysis of the Eye Muscles Following Carbon Monoxide Poisoning. *G. Abelsdorff.* Deut. med. Wchnschr., Feb. 19, 1920, 46, No. 8, 210.—F. B., gardener's helper, exposed to carbon monoxide from a charcoal stove, became unconscious. Later he vomited, and suffered from malaise, dizziness, and headache for two days. On the fourth day a disturbance of vision set in, which became so bad the next day that he could not

recognize large objects. Physical examination was negative, except for a slight horizontal nystagmus. The urine was negative. No carbon monoxide hemoglobin was found in the blood. There were 4,005,000 red cells and 12,900 white cells. Hemoglobin was 85 per cent. The temperature was normal.

On the sixth day the eyes showed: R—hand movements at 1 m., field of vision contracted almost to the fixation point; L—same, without so much contraction. Both eyes showed complete color blindness. The right pupil was wider than the left, but both reacted. The eye movements were free, except that the right lagged on looking up. The ophthalmoscope showed normal fundi, except for a few old depigmented spots at the periphery of the right retina.

In one week, without medication, the vision became: R—6/20; L—6/25. The fields were concentrically contracted, without scotoma. Bright colors were recognized, but in such a way that it suggested congenital color blindness. A red glass placed over the right eye caused diplopia, characteristic of paresis of the left inferior rectus.

At three weeks the paresis was still present, both pupils were equal, vision was normal, the fields were normal, and the finest print could be read at 1/4 m. At four weeks there was no change.

Abelsdorff could find only one other similar case in the literature. Carbon monoxide poisoning of the eyes usually shows some changes in the fundi, such as venous hyperemia, small retinal exudate, or slight optic neuritis. The failure of vision, in this case, accompanied by bilateral concentric contraction of the visual fields, points to acute intracranial neuritis involving the orbit, in spite of normal fundi, because a single central lesion, like a hemorrhage, could not account for it. The quick recovery also favors this view. — H. G. Noyes.

Lumbar Puncture in Carbon Monoxid Poisoning. *Legry* and *J. Lermoyez.* Abstracted as follows from Bull. de l'Acad. de méd., July 27, 1920, 84, No. 29, 67, by Davis in Arch. Dermat. and Syph., Nov., 1920, 2, No. 5, 657–658. — "In carbon monoxid poisoning the reaction must be thought of more as a corticopial congestive and hemorrhagic process which the intoxication produces than as an intoxication. In a recent case, the writers on their first lumbar puncture found a spinal fluid which appeared like almost pure blood. Such evidence of a hemorrhagic state is not constant in all cases. Lesieur and Rebattu have reported cases with spinal fluid free of all anomaly. Though the patient whose case is cited showed a bloody spinal fluid and serious symptoms, his wife and daughter presented only transitory malaise though subjected to precisely the same exposure to the gas. To explain this peculiarity, the authors mention the writings of Balthazard and Nicloux and of Bollet. While in normal persons the coefficient of intoxication is very constant, it is noticeably lowered in the person with a co-existing defect, such as chronic nephritis or hepatic cirrhosis. Other similar visceral alterations can assuredly lower resistance. Regarding their own case, they conclude that the patient's point of weakness lay in the nervous system itself. In the war he had had cerebrospinal meningitis and twice had suffered concussion with loss of consciousness. Such antecedent occurrences are enough to create a special vulnerability to the gas in spite of the small amount inhaled.

"It is suggested that chemical examination of the spinal fluid offers a means of diagnosis in uncertain cases." — K. R. Drinker.

The Action of Benzol. VI. Benzol Vapor Leucopenia (Rabbit). *H. G. Weiskotten, C. B. F. Gibbs, E. O. Boggs* and *E. R. Templeton.* Jour. Med. Research, May, 1920, 41, No. 4, 425–438. — The author concludes as follows:

"1. Exposure of rabbits to benzol vapor with maximal sublethal dosage causes leucopenia, hemorrhages and slight anemia.

"2. The percentage and absolute decrease of small mononuclears is greater than that of polynuclear amphophiles.

"3. Apparently, after discontinuance of exposure, the total leucocyte curve rises to a permanent general level, lower than that existing before exposure. This relative leucopenia is permanent. It is due to a failure of the absolute small mononuclear curve to rise to as high a level as that existing before exposure.

"4. The results of exposure are of the same general nature as those produced by subcutaneous injections of olive oil-benzol mixture. Diphasic leucopenia was not observed." — W. B. Cannon.

Note on the Connection between Herpes Zoster and Arsenic. *Karl Mezei.* Münch. med. Wchnschr., July 16, 1920, 67, No. 29, 844–845. — In December, 1919, a young pa-

tient came to this observer with a typical lumbo-inguinal herpes zoster. She said that she had been taking arsenic for some time on account of anemia. Five months later she returned with a herpes zoster following the distribution of the left radial nerve, a very unusual situation. There were three groups of typical vesicles on an erythematous base, separated by intact skin. The patient said these came out after the twentieth injection of arsenic. A few days before there had been slight itching and formication. Twenty-four hours after the red spots came the vesicles filled with clear serum. An interesting feature of the case was that no pain worth mentioning occurred at either attack. — H. G. Noyes.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Industrial Epidemiology. *W. A. Sawyer.* Jour. Am. Med. Assn., Oct. 16, 1920, 75, No. 16, 1041–1043. — The author discusses the control of the following epidemic diseases from the point of view of the industrial physician.

Smallpox. — Vaccination is required of all new employees, about 50 per cent. of "takes" being secured.

Typhoid. — It is suggested that typhoid vaccine might be administered upon Saturday with return to work on Monday and without loss of time.

Diphtheria. — Throat cultures should be taken in all suspicious cases and the possibility of offering a Schick test to employees considered.

Tuberculosis. — Entrance physical examinations are important and particular attention should be paid to a history of loss of appetite, loss of weight, and general weakness. These symptoms, together with any temperature, should cause very close supervision. The author is apparently convinced that most industries which report but little tuberculosis are not finding and caring for their early cases.

Respiratory Diseases. — The following plan is advocated:

"1. Instruction for all those in a directing or supervising capacity, in recognizing a cold in its incipience, with orders to send to the physician everyone who falls within this group.

"2. Authority to the physician to send home employees who appear ill or have a temperature of 100 or over, and who are sneezing and coughing, or have a profuse discharge from the nose.

"3. Follow up to see that those persons who are sent home receive proper treatment. This should be done by a visiting nurse. This means helping the local health department, in that certain other diseases may be detected in their early stages.

"4. Careful inspection by the physician on their return of all who have been sent home.

"5. Charting of records of sickness incidence by departments so that attention may be quickly turned to those departments showing an increased amount of illness.

"6. Education for all as to methods of prevention, which may be done through plant publications, bulletins, leaflets or lectures.

"7. Proper ventilation, cleanliness of surroundings, prevention of fatigue, and last but not least the avoidance of overcrowding. One has only to visit some of our industries late in the day when all the freshness and sweetness of the air has been vitiated to appreciate how far in the dark ages we are living."

Venereal Diseases. — Education of the employees and helpfulness toward those affected are most important.

The author estimates that in his plant ten and one-half days a year are lost on account of sickness and believes that proper epidemiological supervision can do much to reduce the enormous economic loss so experienced. — C. K. Drinker.

Anthrax as an Occupational Disease. *J. B. Andrews.* U. S. Bur. Labor Statis., Bull. 267, July, 1920, pp. 186. — This is a revision of Bulletin 205 of the Bureau of Labor Statistics.

This very complete bulletin begins with an historical discussion of anthrax and then passes on to a description of the medical aspects of human infection. The industries affected are next considered and both the United States and continental experience are carefully recorded. A whole chapter is devoted to a discussion of the present status of the problem of disinfection and the last chapter to a complete survey of the recommendation for the control and prevention of anthrax. In Appendix A, the United States

rules and regulations pertaining to anthrax are completely described while in Appendix B are quoted in a similar manner the continental regulations. There are ten full-page pictures and one colored page showing anthrax bacilli and three stages of the human skin infection.

From both the public health and industrial point of view this book is a complete study of anthrax. — Leonard Greenburg.

A Reliable Disinfectant Bath for Soda-Water Glasses and Other Drinking and Eating Utensils. *L. E. Sayre* and *F. A. Patty.* Abstracted as follows from Kansas State Board of Health, Bull. 16, 1920, pp. 76–80, by F. L. Mickle in Chem. Abstr., Aug. 20, 1920, 14, No. 16, 2524. — "A laboratory investigation was undertaken to determine whether NaClO solution would serve as an efficient disinfectant bath for washed soda-water glasses. Of 19 solutions of various compositions only those containing available Cl were suitable for a disinfectant bath. Free Cl was not the only factor determining efficiency for 0.04 per cent. was as efficient as 0.1 per cent. available Cl. The degree of alkalinity was found important. The most satisfactory solution was one with 0.05 per cent. available Cl and almost neutral. This bath is harmless to the hands. The formula for the disinfectant bath is given in apothecaries' and metric systems. Twenty-four hour broth cultures of Micrococcus aureus, B. typhosus, and Streptococcus pyogenes were poured into previously sterilized glasses. The glasses were drained, dipped into the disinfectant bath and removed immediately, rinsed with sterile broth and a portion of the broth streaked on agar and incubated. This was an effort to duplicate practical working conditions where the time element would be reduced to a minimum and the usual disinfectants rendered useless. It is recommended that the bath be prepared fresh daily, even though experiments showed it to be germicidal for periods longer than twenty-four hours. Hot water was found not at all efficient. At the fountain, glasses must not be permitted to become entirely dry, but should preferably be washed, then rinsed in tap water and placed in the disinfectant. Rinsing increases efficiency because introduced dish-water raises the alkalinity of the bath." — W. O. Fenn.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Early Surgical Treatment of Burns of the Conjunctiva. *R. Denig.* Am. Jour. Ophth., April, 1920, 3, No. 4, 256–258. — "In the case here reported the tissue burned by chlorinated lime was immediately removed, and mucous membrane from the lip used to replace it. Speedy healing and excellent result followed. This plan is advocated for cases in which there is danger of infiltration of the cornea." — K. R. Drinker.

The Removal of Steel from the Eye from an Industrial Standpoint. *C. A. Clapp.* Abstracted as follows from Am. Jour. Ophth., May, 1920, 3, No. 5, 325, by W. F. Moncreiff in Internat. Abstr. Surg., Sept., 1920, 31, No. 3, 238. — "The author reports a series of 29 cases in 10 (35 per cent.) of which useful vision was obtained after magnet extraction of the foreign body. In 11 cases (38 per cent.) the eye was lost, in 7 (24 per cent.) light perception to motion was retained, and in 4 cases normal vision resulted. Of the 7 patients operated on by the posterior route 5 retained useful vision. In 16 cases the injury occurred in the right eye, and in 12 in the left. The average size of the foreign body was 3.8 by 2 by 1 mm.; the largest was 20 by 5 by 4 mm.; the smallest, 1 by 0.5 by 0.5 mm.

"The author states that until a few years ago his experience had led him to favor the anterior method of extraction but he now prefers the posterior route. It must be borne in mind, however, that each case should be handled according to its particular requirements." — K. R. Drinker.

Some of the Complications Following Foreign Bodies in the Eye. *W. C. Smith.* Abstracted as follows from Internat. Jour. Surg., 1920, 33, p. 59, by T. D. Allen in Internat. Abstr. Surg., June, 1920, 30, No. 6, 483. — "Smith reviews the subject of foreign bodies in the eye, noting especially the most common positions of such bodies and the nature of the complications to which they give rise. He speaks of the necessity for care in the removal of bodies from the center of the cornea in order that undue injury and diminished vision may be avoided. He calls attention to the fact that certain metals enter into chemical combination with the fluids of the eye. The soluble metallic

salt is often extremely irritating and great care should be taken to remove every particle of it.

"Corneal abrasions, although most painful, are often very difficult to see. As an aid in the diagnosis a 2 per cent. fluorescin sodium bicarbonate solution should be used to stain such an area. For the treatment of corneal ulcer Smith recommends aseptic cleansing and a tight bandage. In cases of infection, heat (about 150 degrees F.) is beneficial and not injurious to the corneal tissue.

"All patients with foreign bodies in the eyeball should be sent to an ophthalmic surgeon but if the foreign bodies are of steel and can be localized, an attempt may be made first to extract them with a giant magnet." — K. R. Drinker.

Ocular Lesions Caused by Asphyxiating Gases. *M. Danis.* Am. Jour. Ophth., May, 1920, 3, No. 5, 323–324. — This is a translation by Dr. M. W. Frederick of a paper by Dr. Danis summarizing the results of his observations in the Belgian army of the effects on the eye of various gases used in gas warfare.

Two kinds of gas act principally upon the ocular apparatus: the tear producing and the blistering gases. Of the tear producing gases the most common are: chlorine, bromine, methyl monochloride chloroform, methyl bichloride chloroform, acrolein, acetone bromoform, methyl acetone bromoform, benzyl bromate, benzyl iodide, phenyldichlorarsine, and diphenylchlorarsine.

The symptoms produced by these gases are a sensation first of itching or even of burning, tearing, intense blepharospasm and photophobia, hyperemic bulbar and palpebral conjunctivae, but no ciliary injection or corneal lesions. The symptoms appear immediately after gassing and disappear with no traces in a few days.

The most common blistering gas is mustard gas or dichlorethylsulphide. The lesions caused by this gas consist of conjunctival and ciliary injection preceding violent blepharospasm and photophobia. The hyperemia is in the beginning localized to the parts exposed through the lid aperture. The corneal epithelium may show a slight lesion, or a deep and extensive ulcer may be present. Contraction of the pupil and burns of the eyelid may occur. The prognosis in general is good. — K. R. Drinker.

Alterations in Twilight Vision in Occupational Nystagmus. *L. Weekers.* Am. Jour. Ophth., March, 1920, 3, No. 3, 162–166. — The author emphasizes the importance of general over-fatigue plus a local sensorial fatigue as the cause of the alterations in twilight vision accompanying miners' nystagmus, and instances the frequent hemeralopia of soldiers as comparable to the hemeralopia so pronounced in miners' nystagmus. In the coal miner who does all his work in a poor light, the foveal vision, which would under normal conditions regulate the movements of the eyes, is lacking. Hence there results a sort of visual groping, from the inco-ordination of the movements and also from the visual fatigue.

"On the other hand, binocular vision also must be maintained under abnormal conditions. The broken coal has an angular and crystalline surface. The lamp, lighting some of the facets, is reflected. Each eye sees different facets destroying binocular vision, and fatiguing the eyes."

Insufficient light, the necessity for looking upward, the sudden and frequent passing from light to darkness in going down into and coming up from the mine are all causes of visual fatigue. — K. R. Drinker.

Loss of Industrial Vision. *Walter N. Sharp.* Am. Jour. Ophth., June, 1920, 3, No. 6, 434–435. — The author gives the following table for calculating loss of industrial vision:

"20/200	=	10%	vision	or 90%	loss
20/150	=	35%	"	" 65%	loss
20/100	=	60%	"	" 40%	loss
20/80	=	70%	"	" 30%	loss
20/70	=	75%	"	" 25%	loss
20/60	=	80%	"	" 20%	loss
20/50	=	85%	"	" 15%	loss
20/40	=	90%	"	" 10%	loss
20/30	=	95%	"	" 5%	loss
20/20	=	100%	"	"	no loss."

— K. R. Drinker.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Proceedings of the Sixth Annual Meeting of the International Association of Industrial Accident Boards and Commissions, Toronto, Canada, September 23–26, 1919. U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, pp. 424. — The following is a list of the papers delivered at the 1919 meeting of the International Association of Accident Boards

and Commissions. Minimum requirements in compensation legislation, by Royal Mecker; Some comparisons of workmen's compensation legislation, by F. H. Bohlen; Is a uniform compensation act possible or desirable, by Charles S. Andrus; Lump-sum settlements, by A. B. Funk; Compensation law administration, by Jeremiah F. Connor; Handicaps of competitive state funds, by F. Spencer Baldwin; Replacing the injured man in industry, by William W. Kennard; The larger idea in workmen's compensation, by Will J. French; Problems of medical treatment under the Minnesota act, by John P. Gardiner; Employees engaged in interstate and foreign commerce, by Lindley D. Clark; Attitude of railroad transportation organizations toward federal compensation, by D. L. Cease; Defects in workmen's compensation laws, by John Mitchell; Disabilities as aggravated by pre-existing conditions, by John W. Mowell; Infections of the upper extremities, by P. A. Bendixen; Cancer, with special reference to sarcoma in its relationship to trauma, by Raphael Lewy; Eye injuries, by Frank C. Trebilcock; The need of recognition of better treatment for mental and nervous injuries, by F. D. Donoghue; The securing of proper medical service for injured persons, by J. W. Trask; How can medical service be improved, by Otto P. Geier; How can medical service be improved, by Morton R. Gibbons; How can medical service be improved, by F. H. Thompson; Fractures, by N. A. Powell; Some features of workmen's compensation law and its administration, by Samuel Price; Comparative insurance rates under different systems, by E. E. Watson; Tests of efficiency in workmen's compensation administration, by Carl Hookstadt; Principle and practice of co-operation in industrial relations as embodied in plans of employee representation, by A. H. Young; Study of accident experience, by L. W. Hatch; and Proposed method of comparing workmen's compensation costs under various laws, by T. N. Dean.

The discussion which accompanied these papers is also included in the bulletin under review. — K. R. Drinker.

Our Safety Week in the Border Cities and its Successes. *Jack Robins.* Pub. Health Jour., Aug., 1920, 11, No. 8. 356-358. — The author of this paper which was read at the 1920 Annual Meeting of the Ontario Safety League is the paid secretary of the Border Cities' Safety Council, Windsor. After describing the special efforts during the Safety Week the author gives an account of some of the routine activities of the council. Among these is the establishment of a school of safety instruction which meets twice a month and issues diplomas to regular attendants. This year there will be an additional school for those who hold the diplomas and also a school for truck drivers and automobilists. Safety will, at the same time, be taken up as part of the regular school work for children. It is firmly believed that the best and quickest way to educate the people in safety is to organise local safety councils in each community. — R. M. Hutton.

Accident Prevention in the Pulp and Paper Industry. *A. P. Costigane.* Pub. Health Jour., July, 1920, 11, No. 7, 307–315. — This paper, which was read at the 1920 annual meeting of the Ontario Safety League by Mr. Costigane, secretary and engineer of the Ontario Pulp and Paper Makers' Safety Association, deals with methods of reducing accidents produced by causes other than unguarded machinery. These are estimated at from 75 to 80 per cent. of the total accidents, and reduction can only be obtained with the co-operation of the employees. After reviewing the points to be gained by an educational campaign — briefly, reduction in accidents, lost time and labor turnover, and the establishment of good feeling between employer and employee — Mr. Costigane makes numerous suggestions as to means of stimulating interest. The following may be instanced:

1. *Means of stimulating interest among employees.* — (a) Safeguarding physical hazards; (b) teaching English to foreigners; (c) issuing books containing safety instructions; (d) placing bulletin boards in each department on which should be posted regularly bulletins depicting the causes and results of accidents; (e) exhibiting safety films and giving short safety lectures; (f) arranging matinees for schoolchildren to see safety films, and encouraging essay competitions; (g) designing and distributing safety calendars; (h) encouraging attendance at night schools; (i) formation of safety committees.

2. *Means of stimulating interest among employers.* — (a) Comparative monthly statistics showing the position of each mill in comparison with other mills in the province; (b) chart issued annually classifying all accidents during

the year; (c) letters commenting on accidents which might have been avoided.

It is interesting to note that a fund started by the Canadian Pulp and Paper Association for the compilation of textbooks on the industry was supported by all the mills in the association and that a fund of $30,000 has been raised from mills in Canada and the U. S. A. It is also interesting to find definitely formulated in this paper the view of the Canadian Pulp and Paper Association that education makes for efficiency and efficiency for reduction of accidents. — R. M. Hutton.

The Employment and Preservation of Explosives. *Junghans.* Zentralbl. f. Gewerbehyg., May, 1920, 8, No. 5, 86–90. — This article is a continuation and conclusion of a study of the necessary precautions in the use of explosives, evidently with especial reference to blasting. The author sums up his advice in a long list of "don'ts," most of them somewhat obvious and presumably generally practiced. They include such precautions as the following: to avoid examining too soon loads that have failed to discharge; to avoid careless handling of explosive caps; to avoid carelessness in the use of electrical firing apparatus, such as using defective wires, making loose connections, using electrical apparatus during a thunder storm, and the like. There are cautions about the proper handling of dynamite, about the exposure of explosives to high or to low temperatures, to dampness, about using frozen or chilled dynamite, and in respect to following carefully the directions given by the dealer in regard to warming. — G. E. Partridge.

Circular Saws and Accident Prevention. *A. Preuss.* Zentralbl. f. Gewerbehyg., June, 1920, 8, No. 6, 97–101. — The war has destroyed the fine sense of precaution which formerly existed in the industrial life, but it must be cultivated once more. Industrial accidents are a serious menace, and they are destructive of valuable man power which cannot well be spared. The present requirements in the matter of protection against accidents in the use of machine saws demand that saw-hoods and wedges shall be provided, properly placed with reference to the cutting surfaces, etc. The upper edge of the saw is to be covered so far as the nature of the work will allow, and the blocks are to be regulated with regard to distance from the saw teeth. These requirements leave much to be desired, due to the conditions that arise from the use of several sizes of saws on the same equipment and the necessity for frequent changes in adjustment, etc. The writer shows by diagram an automatic device for remedying these difficulties — a device first described in a report of the activities of the Technical Superintendence Board of the Thuringian Builders' Trade Co-operative Association, made in 1913. This device is described as a self-acting protecting hood. It consists of a heavy hood with a curved under surface, fixed at one end back of the saw, and balanced at the front end by a weight and pulley. This hood is evidently raised and lowered by the advancement or withdrawal of the materials in use, exposing the surface of the saw as required, and at the same time serving as a block to the materials and a protection for the hand. The device can best be understood by referring to the diagram. — G. E. Partridge.

INDUSTRIAL SURGERY

Some Practical Points in Minor Industrial Surgery. *Wickes Washburn.* Am. Jour. Surgery, April, 1920, 34, No. 4, 108–109. — The author discusses the treatment of mashed fingers, of wounds by barbed wire, and of wounds where fracture is suspected, and cites cases illustrating the results of his treatment. Early, persistent, and thorough manipulation of joints is stressed. — K. R. Drinker.

The Paraffin Treatment of Burns. *A. J. Hull.* Abstracted as follows from Jour. Roy. Army Med. Corps, 1920, 34, p. 151, by I. W. Bach in Internat. Abstr. Surg., June, 1920, 30, No. 6, 461. — "The burn is first washed with normal saline (or a 1:1,000 solution of flavine or proflavine) and then dried with gauze or an electric dryer. A layer of paraffin is then applied at a temperature between 55 and 60 degrees C. Over the paraffin is spread a thin layer of wool, and over the wool a second layer of paraffin. Then another layer of wool and a bandage are applied. This dressing is changed every twenty-four hours. It is important to apply the paraffin in sufficiently thick layers and at the correct temperature.

"By the method described the epithelium is conserved from damage and the tissues are held at rest. It was found that paraffin to which antiseptics were added gave better results than paraffin not containing antiseptics. Experiments to improve the base demonstrated that No. 7 paraffin is the best. The first antiseptic combined with the paraffin was eucalyptus oil used with beta-naphthol. Later flavine was employed and gave very satisfactory results. Paraffin preparations of brilliant green and chloramine-T were not satisfactory from a pharmaceutical standpoint.

"In other experiments it was found that excellent results were obtained when the antiseptic was painted on the wound before the application of the paraffin. Accordingly, with the exception of flavine paraffin and scarlet-red, the special paraffin preparations have been discarded.

"In studies of the effects of the various antiseptics it was found that eusol accelerated the cleaning of the burn but was too irritating in its action. Brilliant green cleaned the wound well but if used beyond a certain stage caused the formation of light-colored and unhealthy granulations. Flavine cleaned the surface well and produced a healthy type of granulation. Scarlet-red should be used only when the burn is clean and requires stimulation. The aqueous solution should be painted over the wound before the application of the paraffin. Both a 1 per cent. and a 10 per cent. solution have been tried but in most cases the former was sufficient. The treatment giving the best results and obviating pain, sepsis, and other complications is preliminary painting of the wound with a 1:1,000 aqueous solution of flavine followed by the application of No. 7 paraffin. In burns of long duration a 1 per cent. solution of scarlet-red should be substituted for the flavine." — K. R. Drinker.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Diets of Laboring Classes during the War. *Margaret Ferguson.* Abstracted as follows from Jour. Hyg., 1920, 18, pp. 409–416, by W. D. H. in Physiol. Abstr., May, 1920, 5, No. 2, 90. — "A useful summary of the authoress's statistical summary of the same families during different periods (pre-war, voluntary rationing, compulsory rationing, etc.). Shortage of some articles was made up for by greater use of others, especially flour. Income was a more potent factor than legislative restrictions. Interruption of growth followed insufficient food." — McKeen Cattell.

Zinc and Copper, Regular Constituents of the Human Body. *E. Rost.* Abstracted from Die Umschau, 1920, 24, 201–202, by J. S. Hepburn in Chem. Abstr., July 10, 1920, 14, No. 13, 2034. — "If brass foundry workers be excluded from the plant, they continue to excrete determinable amounts of Zn and Cu in the feces. Many healthy persons, who have not worked in such foundries, and who have not used Zn-containing medicines or cosmetics, regularly excrete Zn and Cu in the feces and the urine. The average daily excretion was found to be 0.6 to 1.6 mg. ZnO in the urine, and 9 mg. ZnO in the feces, although it has been as high as 39 mg. in the latter. Cu was excreted in considerably smaller amounts. While some foods, such as milk and jams from sour fruits, may obtain their Zn and Cu from the metallic containers or vessels used in cooking, these two metals also occur in other foods which are not subject to such sources of contamination; thus the Zn content (mg. Zn per kg. of sample) was: meat (beef, veal, pork, mutton, horse) 26 to 50, beef liver as high as 83, horse liver as high as 339, sea fish 4, hen eggs 9.8 (*i. e.*, 0.5 mg. per egg), bread 5 to 8, potatoes 2.3, dried vegetables 6.13. Cu occurred in the meat and the liver in smaller amount; one beef liver, however, contained 119 mg. Cu per kg. of organ. The Zn present in foods is derived directly or indirectly from the soil, or from water which has flowed through galvanized iron pipes. In man, the Zn content (mg. Zn per kg. of organ) was: liver 52 to 146, musculature 47 to 52, brain 11; the Cu content of these organs was less. The blood of cattle contained Zn; and the amount of that element, in mg. per liter, present in milk was: cow 3.9, goat 2.3, human 1.3. The traces of Zn are absorbed from the gastro-intestinal tract, stored in the muscles and the liver, pass into the body fluids, and thence into the urine, the feces, and the milk. Zn has not been found in Swiss

cheese, beet sugar, or beer. Under present conditions Zn and Cu are regular, though accidental, constituents of the human, animal, and plant organism; the quantity in the food is unavoidable, and injures neither the digestive apparatus nor any other part of the body. However, neither Zn vessels nor those coated with Zn should be used in cooking or storing foods which are acid or likely to become acid; otherwise Zn salts may be formed and ingested in sufficient amount to irritate the mucosa of the stomach and intestines, and to produce other ill effects." — W. O. Fenn.

The Blood in Fatigue. *Otto Burkard.* Il Lavoro, July 31, 1920, 12, No. 3, 80–82. — An abstract of a paper prepared for the International Congress of Industrial Hygiene which was to have been held in Vienna, August, 1914. According to the investigations of Grawitz, Rosenthal and Wagner, fatiguing work results in a true leukocytosis. During the early stages of labor, there is an increase of leukocytes which remains stationary until fatigue begins; then there is a diminution, and after rest the number becomes normal again. The increase during the first period is at the expense of the lymphocytes, but these then diminish giving place to the neutrophils, the muscles during work producing substances which pass into the blood and provoke a reaction in the bone marrow. Grawitz holds that this myogenous leukocytosis is necessary for the removal from the organism of the toxic products of fatigue. Burkard believes that the continual daily stimulation of the hematopoietic tissues may end in injury to these tissues and to the whole body. He calls attention to the fact that the only neutrophil cells found in normal blood are the mature forms — the polynuclear — and that the presence of mononuclear neutrophils cannot be physiological, but is a proof that the stimulus to blood formation has passed the normal point. He examined ten young workmen in a glass factory who were transporting glass to chilling rooms for the nine hours of their working day. He made his blood smears at the beginning of work, after three hours, and after nine hours, and noted in certain cases an increase of neutrophils, especially of pathological forms, the increase being in proportion to the work done. He thinks that this blood picture may be used to detect fatigue, which has passed physiological bounds, before it has given rise to symptoms of ill health. — A. Hamilton.

Influence of Six-Hour Day on Efficiency and Fatigue. *H. M. Vernon.* Fatigue and Village Meeting-Halls. *C. Smith-Rossie.* Measurement by CO_2 of Energy Output. *A. D. Waller.* Abstracted as follows from Brit. Assn. Rep., 1919, pp. 308–313, by W. D. H. in Physiol. Abstr., Aug., 1920, 5, No. 5, 213. — "A series of papers related to an important practical use of physiological data." — McKeen Cattell.

The Physiological Cost of Muscular Work Measured by the Discharge of CO_2. I. The Energy Output of Dock Laborers during "Heavy Work." *A. D. Waller.* Abstracted as follows from Proc. Roy. Soc., 1920, 91B, pp. 166–185, by D. H. de S. in Physiol. Abstr., June, 1920, 5, No. 3, 136. — A preliminary communication on the subject of this paper has already been noticed (Jour. Indust. Hyg., Vol. 1, p. 41). — "The author finds that the hourly cost of piece-work is 175 calories per hour per square metre, that of time-work 100. A healthy young man, fit for military service, can do at least 100,000 kg.-metres per day, and a mechanical task of 200,000 per day is beyond his power. A table is given comparing the results with those of other workers." — McKeen Cattell.

The Physiological Cost of Muscular Work. *A. D. Waller.* Abstracted as follows from Brit. Med. Jour., 1920, 1, pp. 537–538, by D. H. de S. in Physiol. Abstr., June, 1920, 5, No. 3, 136. — "The average rate of energy output (gross) of four compositors for one week was 101 to 105 calories per hour." — McKeen Cattell.

Physiological Cost of Muscular Work. II. Cold Storage Laborers. *A. D. Waller* and *G. de Decker.* Abstracted as follows from Proc. Roy. Soc., 1920, 91B, pp. 229–248, by W. D. H. in Physiol. Abstr., Aug., 1920, 5, No. 5, 242. — "The paper presents full details of numerous observations on the cost of work as measured by CO_2 output. The general results on this class of laborers bear out the author's thesis maintained in several previous publications." — McKeen Cattell.

Energy Expenditure in Minor Duties. *E. P. Cathcart* and *F. J. Trafford.* Abstracted as follows from Proc. Physiol. Soc., 1920, Jour. Physiol., 53, p. xcix, by W. D. H. in Physiol.

Abstr., July, 1920, 5, No. 4, 188. — "Data are given for the expenditure in brushing boots, washing hands, window cleaning, and scrubbing floors. The calories expended per square metre per minute average 1.4, 1.5, 1.8, and 2.1 respectively." — McKeen Cattell.

Physiological Cost of Printer's Work. *A. D. Waller* and *G. de Decker*. Abstracted as follows from Proc. Physiol. Soc., 1920, Jour. Physiol., 1920, 53, pp. civ–cvii, by W. D. H. in Physiol. Abstr., July, 1920, 5, No. 4, 188. — "Work on the lines of previous work. The heavier the labor, the greater is the output of CO_2. Cerebral work (proof-reading) has no appreciable effect." — McKeen Cattell.

Metrotherapy, or the Measure of Voluntary Movement: Its Value in Surgical Reconstruction. *Fred H. Albee* and *A. R. Gilliland*. Jour. Am. Med. Assn., Oct. 9, 1920, 75, No. 15, 983–986. — The authors describe various forms of apparatus for use in cases where movement of a part is restricted as a result of injury, which permit accurate measurement of improvement. The term "metrotherapy" is given to such measurements since it has been found that the psychic stimulation which a patient obtains from steadily observing and recording improvement really makes the simple matter of measuring a valuable therapeutic adjunct.

The apparatus used and the case reports given must be followed in the original article in order to be appreciated. — C. K. Drinker.

Observations on the Physical Efficiency Tests Used by the Royal Air Force of England. *E. C. Schneider*. Abstracted as follows from Proc. Am. Physiol. Soc., 1919; Am. Jour. Physiol., 51, pp. 179–180, by G. D. C. in Physiol. Abstr., June, 1920, 5, No. 3, 114. — "An analysis of the records of American aviators who underwent the physical efficiency tests of the R. A. F. in England led to the conclusion that the tests were not a trustworthy indication of the capacity of a man to respond to low oxygen tensions. The tests depended too much on the hearty co-operation and the complete attention of the subject." — McKeen Cattell.

Effect of Breathing Dry and Moist Air. *E. P. Lyon* and *E. Greisheimer*. Abstracted as follows from Proc. Am. Physiol. Soc., 1919; Am. Jour. Physiol., 51, p. 191, by G. D. C. in Physiol. Abstr., June, 1920, 5, No. 3, 132. — "Tentative results of breathing air at 20–30° C., with humidity 10 and 90 per cent. respectively (temperature of room being 20–22° C. and humidity 50–60 per cent.), were higher pulse rate, lower respiration rate, higher arterial pressure, greater peripheral vascularity in breathing moist than dry air." — McKeen Cattell.

Artificial Respiration with and without the Addition of High Concentrations of Oxygen. *Wauer*. Zentralbl. f. Gewerbehyg., Aug., 1920, 8, No. 8, 159–165. — The author abstracts and comments upon a published military report on the subject by A. Loewy and G. Meyer. The Sylvester method for artificial respiration is shown to give greater lung ventilation per minute than the Howard method, and is said to have no greater difficulty in the hands of inexperienced operators than the Howard. A tongue halter is recommended for either method, the desirability of turning of the head sharply to one side to maintain a passage through the pharynx not being considered sufficiently demonstrated. Wauer thinks this latter method should be taught.

The apparatus used in the army was hardly ample to supply oxygen for continuous use in the Sylvester method. It was found feasible to combine artificial respiration with the use of oxygen. Unless the war gas mask was used, no tongue halter could be used. Concentrations of oxygen varied, but due to loose masks and design of apparatus it never reached 100 per cent. oxygen, which they confirmed by animal experiments as being toxic if continued. There was no ozone in the oxygen.

The use of oxygen in carbon monoxide poisoning hastens recovery by raising the concentration of oxygen in the blood and facilitating the separation of carbon monoxide from hemoglobin.

Different types of apparatus are described and criticized. The Sylvester method with simple mechanical aids is sufficient except in carbon monoxide poisoning where they recommend the addition of oxygen from a bomb. — E. L. Sevringhaus.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Mishaps from Electricity; Rescue Work. *M. D'Halluin.* Journal de Radiologie et d' Electrologie, June, 1920, 4, No. 6, 254. Abstracted as follows in Jour. Am. Med. Assn., Nov. 6, 1920, 75, No. 19, 1297. — "D'Halluin's research on dogs has confirmed the importance of fibrillation as a most serious effect of exposure to an electric overcharge. The respiratory phenomena should be combatted by the classic measures, bnt the phenomena on the part of the heart, primary or secondary, call for immediate application of massage to the heart, although not with much hope of arresting the fibrillation by this means alone. But we have in intravenous injections of potassium chlorid, he continues, a simple means to combat this irregularity of the heart, applied in connection with massage. This drug is a poison for the heart muscle, but it becomes diluted in the blood stream. The fatal dose is 14 cg. per kg., if injected rapidly, but up to 33 cg. can be borne injected slowly. His practice in dogs is to inject a 5 per cent. solution into the jugular vein, in the dose of 4 c.c. per kilogram of weight. Instantaneously the fibrillation ceases. Continuing the massage of the heart for five minutes, ten mintues, or even longer, the heart begins to contract again. He asks 'Why not apply to man this treatment which has proved so effectual on dogs?' Before he had learned of this efficacy of potassium chlorid he lost 63 per cent. of the dogs after inducing the fibrillation, the massage alone not being enough to resuscitate them, but after injection of the drug, he saved 65 per cent. even when the massage was not begnn until ten or fifteen minutes after the arrest of the heart. He remarks that the desired effect would probably be realized with a proportionally much smaller amount than 4 c.c. per kg. This drug seems to combine the greatest potency with the least harmful action of the large number of measures he tested." — M. C. Shorley.

WOMEN AND CHILDREN IN INDUSTRY

Further Suggestions for the Preparation and Placing of Women as Industrial Inspectors. *Hertha Bernecker.* Comment by *Matthes.* Zentralbl. f. Gewerbehyg., Sept., 1920, 8, No. 9, 176–179. — Fräulein Bernecker is convinced that woman by reason of her sex is particularly adapted for the industrial protection of women and children, and consequently suggests the possibility of separating this part from the general field of industrial inspection. To this new department the author would give authority for co-operative inspection in all industries employing women, children or homeworkers, and consideration of all cases which might arise from these classes of workers. Liaison between employer and employee would be no small part of the work of these new women inspectors.

Although perhaps at first forced to occupy the same quarters as the existent inspectors, complete independence of judgment and of action will be the only way of attracting truly competent women, scientifically and practically trained. Auxiliary inspectors may be drawn from among the working women themselves in the crowded industrial centers.

As "conscientious" preparation for such a career, Fräulein Bernecker advocates the completion with examination of four semesters of university work, with compulsory economics and jurisprudence, at a higher institution of learning. This is to be followed by a year's practice in factory work as toiler and forewoman. After another year spent in a woman's social training school recognized by the government, twelve months' employment as industrial inspector would complete the education. Final placement would follow the passing of a rigid government examination for women industrial inspectors.

Five years is set as the period of transition.

Matthes considers Fräulein Bernecker's plan too extensive. Not only do the present financial difficulties of the government argue against this change, but the question of the place of academically trained women in such positions seems to be still unsettled. Aid for working women and girls belongs more in the sphere of activities of the factory nurse and charity establishment. Besides, the separation of male and female industrial inspection would give rise to

so many conflicts that it should not even be considered. — H. V. Williams.

The Work of Women on Tramways. *A. Ranelletti* and *Fraschetti.* Abstracted from Bollettino dell' Ufficio Municipale del Lavoro, 1919 in Il Lavoro, July 31, 1920, 12, No. 3, 82–83. — The authors examined 380 women — 49 of them motormen, and 331 conductors — who had been employed on the tramways for at least six months. Most of them were between 22 and 40 years of age and had previously done only domestic work. The effects of the work seemed to be an increase of menstrual disturbances — excessive flow and severe pain — anemia, and pharyngolaryngitis. The authors think that the cause of these complaints is to be found in the prolonged standing which sometimes lasted twelve or thirteen hours, night work, exposure to cold, and unhealthful conditions in the tram-cars. The majority of women were not able to do work of this sort without injury to their health. — A. Hamilton.

Need of Protecting the Health of Working Children. *Harold H. Mitchell.* Mod. Med., July, 1920, 2, No. 7, 517. — It is estimated that about three-quarters of a million children in the United States between the ages of 14 and 15 years go to work. Most of them engage in occupations dependent upon their manual capacity. This means that good health is the greatest single factor in their remaining satisfactorily employed. It also means that the greatest possible demands are made upon their physical resources. They are more liable to injuries from the various industrial hazards than adults. The child labor health problem demands careful medical examination before employment so that only the physically fit shall be allowed to enter industry. Such examinations should result in the correction of all possible physical defects. When necessary subsequent examinations should be made and children permitted to remain employed only when their physical condition is satisfactory. Another important step in the preservation of the health of the working minor should be adequate instruction in health matters. — C. H. Paull.

Industrial Child Labor during the War. *W. Rohde.* Concordia, Jan. 1, 1920, 27, No. 1, 2–3. — The Prussian industrial reports show that with a decreasing demand in some lines of legal employment for children and an increasing demand for labor in manufacturing there has been much illegal employment of children. This was made easier by poor school registration and overburdened officials who took a more lenient attitude toward violations of the laws. Other war conditions and excuses are offered. The revolution of November, 1918, with all its unemployment has brought the status of child labor largely to the pre-war condition. — E. L. Sevringhaus.

The Industrial Employment of Young Laborers and Children in 1914–18. Concordia, Feb. 15, 1920, 27, No. 4, 37–41. Published reports of the government industrial officials show that, during 1914–18, in the different parts of Germany the employment of young labor in industry very considerably increased. Apprenticeships suffered and for a long time men were trained for skill in no more than one job. Many complaints were made of the conduct of the workers in and out of the factory. There was much night work, less overtime work, and a minimum of Sunday work. The reports show no attention paid to the problems of the health of the workers.

Children under 14 were also widely employed, the officials permitting violations of the law against child labor except in flagrant abuse of the children. Children were employed even in dangerous industries such as lead and zinc works. Return to former legal restrictions will be difficult since parents, teachers, employers and officials have yielded to economic pressure during the war. — E. L. Sevringhaus.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Relation of Metal Mine Ventilation to Safety and Efficiency. *D. Harrington.* Safety Engin., Aug., 1920, 40, No. 2, 65–67.— The desirability of efficient control of air currents and the necessity of supplying metal mine workers with better and safer working conditions have created an active interest in metal mine ventilation. Whereas in coal mines ventilation is generally considered as essential, in many metal mines, especially shallow ones,

the operators pay little attention to ventilation, or ignore it altogether. There is, in fact, greater necessity for adequate ventilation of metal mines than of coal mines. The latter require air currents to remove explosive gases and the fumes of explosives, but metal mines, in addition to the need of removing fumes of explosives, and occasionally explosive gases, frequently have need of removing dusts dangerous to health, reduction of high temperatures and high humidity, and the removal of inert but unhealthful gases like carbon dioxide and nitrogen. The generally accepted superior health of coal miners as compared with metal miners is probably due in large part to the better circulation in working places of coal miners. The principal factors of metal mine ventilation as related to health and safety are the effects of ventilation on high temperature, high humidity, gases and dusts. — R. M. Thomson.

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Ideals in the Organization of an Industrial Medical Service. *Emery R. Hayhurst.* Am. Jour. Pub. Health, Sept., 1920, 10, No. 9, 715. — This brief article is a plea for the plant medical department to be managed by a committee representative of both employer and employees with at least one representative of the local board of health. Representation should be proportional with the local health representative having the deciding vote in case of a divided opinion, or in cases of importance reference to a higher state committee composed of representatives from the local or state manufacturer's association, workmen's organization, chamber of commerce and the state board of health. The cost of the industrial medical service should be divided, the industry paying for the equipment but maintenance being charged partly to employees and partly to the direct cost of production. — H. F. Smyth.

A Program for Organizing and Co-ordinating Industrial Clinics. *Bernard J. Newman.* Am. Jour. Pub. Health, Aug., 1920, 10, No. 8, 637. — The author summarizes various economic conditions of recent development which are forcing an industrial health program and developing the need for the industrial clinic. He dwells on the unreliability of much of the present information as to occupational poisons and other health hazards of trade. The properly co-ordinated industrial clinic has great value as a clearing house of information and a research center. Various ways are enumerated in which such clinics may be of value to the worker, the general practitioner, and the community, and may act as a neutral agency for physical examinations, advice, treatment, consultation, research and influence on protective legislation. References are made to clinics already established, such as that of Professor Devoto in Milan, Italy, and those in New York City, Boston, Philadelphia, and Chicago. No definite plans of organization are given as such clinics should be adapted to the environment and should be established only after a study of the industries, nationalities, and resources of the community to be served. Suggestions are made, however, as to personnel, advisory council, equipment and financing, and the value of standard forms of record keeping is insisted upon. The forms developed by the Office of Industrial Hygiene and Sanitation of the U. S. P. H. Service are recommended and the advisory services of this office are offered wherever the establishment of such a clinic is contemplated. — H. F. Smyth.

The Group Industrial Surgical Hospital. *A. Moncrieff Carr.* Mod. Med., June, 1920, 2, No. 6, 426–430. — By a group industrial hospital is meant a hospital serving a group of industries. Few single industries can afford to maintain establishments and employ the necessary skilled help. So we have a few large industries fairly well served, but many small industries are not able to secure the best surgical skill or hospital facilities. At present the great mass of injured are treated in general hospitals and no special care is given. The industrial surgical hospital should be a central hospital, with outlying dressing or emergency stations, organized for prompt, efficient emergency and surgical service for a group of industries. It should be developed with a view for the special needs of the group. A description of the personnel which such a hospital would require is herewith given, also detailed descriptions of the architectural plan for the group industrial surgical hospital, the receiving department, the

examining department, ambulance service, the surgical department, the ward for medical cases, laboratory and X-ray department, commissary department, quartermaster's department, follow-up and social service, record system, etc. — L. A. Shaw.

Plant Dispensaries and Their Equipment. *C. D. Selby.* Hosp. Management, April, 1920, 9, No. 4, 56–62; May, 1920, 9, No. 5, 56–60. — The author emphasizes the following six points which are essential to good service in plant dispensaries:

1. Plant dispensaries should be accessibly located.
2. The arrangement of the rooms should be such that those which are used most will be most accessible.
3. Equipment should be grouped in units and the units so arranged that those most used will be most accessible.
4. Personnel should be pleasant and pleasing to look at, as well as versed in knowledge and trained in technic.
5. Patients should be treated with the same consideration and conscientious attention as though they were private patients.
6. Records should concern individual cases of injury and illness, chronological histories of each workman, and show in summary form the variety and volume of cases occurring. — L. A. Shaw.

Consultant Medical Service on a Graduated Income Basis. Lancet, July 3, 1920, 199, No. 5053, 26. — Messrs. Thomas de la Rue and Company, Ltd., a London business house, have met with such success in their experiment in providing a complete medical service for their staff and workpeople that they are now commending it to other companies. In accordance with the arrangements made by this company, a number of consulting physicians and surgeons have agreed to treat privately at reduced fees patients sent to them by the company, the fees to be based upon what is described as "adjusted income." This includes private means as well as salary, one-fifth of the total being deducted on account of a wife, and a further one-tenth on account of each child or other dependent. The fees vary from 10 to 60 per cent. of the usual charge for operations and from 25 to 100 per cent. in the case of consultations and medical treatment. In order to avoid cases being sent to the consultant staff without due cause, a certificate is required in each case from the company's medical adviser, together with a voucher stating the proportion of the normal medical fee payable by the patient. A further proposal is now made with a view to providing a central nursing home for employees from a number of business houses at reduced fees. — M. C. Shorley.

A Physical Therapeutic Centre: An Experiment by the North Staffordshire Coal and Iron Masters along the Suggested Lines of Future Medical Service. *T. Lister Llewellyn.* Brit. Med. Jour , Sept. 18, 1920, 2, No. 3116, 434–436. — An account of the establishment and the results of the first year's working of a "massage centre" for the treatment of injured workmen is given. The employers of the coal and iron industries of this district found that much time was lost by the workmen during convalescence from fractures and other injuries. It was also shown that local hospitals were overcrowded and the local physicians were not able to carry out the massage and the necessary after-treatment for such cases. Hence the "massage centre" was established by the employers to provide free treatment to their employees. During the first six months 181 cases were treated and during the second six months 310 were treated, thus showing the increasing popularity of the centre. It is estimated on the basis of the present compensation rate of 35*s.* per week, that if the injured man's return to work can be expedited by one week, the centre will be a financial success. The employers are convinced that this result has been achieved and have decided to make the centre permanent. The results seem to show that both employers and employees are benefited by the establishment of this centre. — J. T. Wearn.

Medical Director at Department Meetings. *A. S. Jones.* Hosp. Management, June, 1920, 9, No. 6, 54–56. — The manner in which the dispensary work at the Shamokin plants of J. H. and C. K. Eagle, Inc., is carried on is described in this article. The equipment consists of the dispensary and treatment room with necessary surgical and medical instruments. The hazards encountered in this industry — the manufacture of silk — are not extraordinary or serious. To outline more clearly the scope, activities and methods of the medical department, it is considered under the following heads: (a) surgical treatment, preventive surgery; (b) medical treatment, preventive medicine; (c) sanitary and safety inspection;

(d) co-operation with the employment department, including welfare work, education, forms used, physical inspection of applicants for work; (e) first-aid work; and (f) extension to other plants and future development.

In certain cases an outside physician is employed. If financial aid is needed, it is quietly furnished. There is no desire, however, that the employees should become objects of public charity.

In the dispensary a daily record is kept of every patient. In the event that medical examination indicates a condition which requires attention but does not disqualify the employee for work, a clinical record card is started and a "follow-up" instituted. — L. A. Shaw.

The Medical Department at E. W. Bliss Company. *Donald W. Gildersleeve.* Mod. Med., Aug., 1920, 2, No. 8, 559–564. — The medical department of this company as it is administered at the present time has been in existence for six years. The department is under the control of a medical director who, in addition to his general executive duties, has charge of the clinic for injured employees and visits them at their homes when such visits are necessary. All cases requiring unusual medical service are referred to specialists. The relief work of the medical department is supplemented through the activities of an employees' association which renders financial assistance to workers.

Taking the Brooklyn plant of this company as the most adequate illustration of its medical work, the writer points out that besides the central offices there are four emergency rooms. The staff of nurses and men in charge of the emergency rooms is augmented by two clinical assistants and a secretary of the department. The employment of the secretary relieves the medical director of a large amount of routine work, such as the keeping and filing of records, handling of compensation checks, etc.

The physical examination of the employees is conducted by the medical director, the character of the examination being to some extent determined by the type of work for which the individual is hired. The examining of new employees is a comparatively new procedure. Of the first thousand physical examinations given, 96 per cent. of the individuals examined were accepted for employment. Although the return to the company from the physical examination has been wholly adequate, employees have benefited even more. Employees are carefully advised as to their condition and there is a follow-up of cases of physical defects.

Emergency rooms are provided with equipment for first-aid treatment. Those in charge of the rooms are thoroughly instructed as to whether treatments should be given there, whether patients should be sent to the hospital, or what other disposition should be made of each case. In this way much loss of time is prevented.

As an adjunct of the actual work of the various branches of the medical department a system of record forms has been developed. Reproductions of a number of these forms are given in the article. They cover notice of employment to the medical office, examination notice, physical examination record, and periodic report forms.

Among the general observations made by the writer is his comment on the economy of time and money through the thorough organization of the department and the adequate delegation of duties. He calls particular attention to the human side of industrial medical work. The worker must be made to feel that his interests and those of the medical department are identical. Although a great many cases pass through the various agencies of this department, it must be definitely understood that each case is one which deserves individual consideration and sympathetic treatment. — C. H. Paull.

The Experience of the Medical Department at Nitro, West Virginia. *J. A. Watkins.* Mod. Med., April, 1920, 2, No. 4, 293–297; May, 1920, 2, No. 5, 370–377; June, 1920, 2, No. 6, 432–437; July, 1920, 2, No. 7, 494–497. — This series of articles under the general title indicated present an account of the development and administration of the work of the medical department at Nitro, West Virginia. On Jan. 1, 1918 the site of Nitro was occupied by farms. One hundred and eighty days later its industrial plant employed 22,000; it was a city of 1200 homes with schools, churches, a theatre and a bank. The two great problems which faced the men in charge of the medical work were (1) the variety and shifting character of the population, and (2) certain health conditions dependent upon the locality and upon the facilities which could be afforded in the development of so large a project in so short a time. The size of the undertaking can perhaps be best understood by remembering that

in the middle of February the personnel of the medical department consisted only of the medical officer in charge. By the middle of November of the same year this force had grown to 800 persons, including medical officers, nurses, hospital employees, X-ray and laboratory technicians, and an administrative and clerical force to carry on the ever-increasing sanitary work of the community.

The work of physical examination and medical supervision was developed with the following aims: (1) "The prevention of introduction of communicable diseases; (2) the avoidance of employment of persons who either by reason of physical or mental disability might be a factor in the causation of accidents; (3) the discovery of remedial defects, in order that proper medical and surgical steps could be taken; (4) the determination of mental and physical status of the applicant for employment; (5) the exclusion of those who, either by reason of physical or mental disability were incapable of performing labor of the type which was available; (6) the discovery of venereal infections and other infectious diseases; (7) to bring individuals into close contact with medical officers."

After examination, applicants for employment were classified as follows: (1) permanently rejected; (2) temporarily rejected; (3) enrolled with disability noted; (4) certified for specified employment.

Applicants for physical examination were first sent to the dressing room where they stripped completely, placing all their clothing in a large canvas bag and valuables in a small bag. From here they went to the shower bath where they were given soap and towel, being under the observation of an attendant. From here they proceeded to the record clerk where they were weighed. In the examining room a complete physical examination was given, and each individual was vaccinated against smallpox and inoculated for typhoid. A thumb print was also taken in the examining room. After passing from the examining room the applicant was given his clothing which, in the meantime, had been searched for vermin and drugs and thoroughly sterilized. The following is a summary of the results of physical examinations:

Total number rejected	621 or	0.8 per cent.
Temporarily rejected	6,697 or	8.8 per cent.
Immediately passed and employed	69,680 or	90.4 per cent.
Total passed and employed	76,377 or	99.2 per cent.
Total number of men examined	76,998	
Total number of examinations made	94,438	

Other summaries are included in this article giving detailed causes for temporary and permanent rejections, women enrolled with disabilities, etc.

The activities of the industrial hygiene service included (1) "general activities which had to do with the organization and maintenance of conditions which are applicable to industries in general; and (2) special hygienic measures which dealt with conditions brought out because of the special industrial processes carried on at Nitro."

Workmen and their dependents were housed in Nitro either in barracks or in bungalows. There were sixty-seven barracks and 1253 bungalows. In the barracks careful supervision of living conditions was placed in the hands of inspectors, one being assigned to each of the barracks. Special supervision of mess halls was maintained and bi-monthly examinations of all employees made.

Unusually drastic measures were instituted for the prevention of communicable diseases. Special care was taken to discover and segregate for treatment cases of venereal infection. The data recorded in connection with this work are particularly enlightening.

In the early days of the work at Nitro the water supply was quite inadequate. Typhoid fever had been prevalent in the vicinity for a number of years. The milk supply was limited and unsafe. A total of 105 cases of typhoid received medical attention, though only fifty-one were confirmed by laboratory diagnosis. A study of these fifty-one cases tended to show that immunity through the use of vaccine comes only some time after the completion of the treatment.

The carrying on of emergency relief work throughout the plant was complicated by the area covered. The first-aid activities of the medical department followed two lines: (1) "The organization and maintenance of suitable locations throughout the plant of first-aid apparatus, equipment, and material; (2) the instruction of the better informed employees . . . in standard and approved methods of procedure in rendering relief." A summary table is given in the July installment of this article of all injuries, which numbered 10,697. More than 3,000 ambulance calls were answered. Twenty per cent. of all calls were made during the first hour the men were at work and 16 per cent. during the last hour of work. The remaining 64 per cent. were fairly evenly distributed over

the working time, except that 90 per cent. of the sick calls came about midnight.

The July installment also contains a brief discussion of the various types of injuries treated in the general hospital. — C. H. Paull.

The Service Department of the R. K. LeBlond Machine Company. *Sanford De Hart.* Mod. Medicine, May, 1920, 2, No. 5, 365–368. — In this plant the social service department and the hospital department are under separate management. The hospital department is housed in nine rooms: waiting room, first-aid room, bacteriological laboratory and operating room, office, dental room, dark room for eye work, bedroom and sterilizing room. The hospital department was organized to accomplish two purposes: (1) to take care of all injuries with the greatest expedition; and (2) to supervise the health of the workers. It also furnishes a means of contact between the workers and the management. With a working force of 1000, this plant during 1919 furnished 15,183 treatments. During the year no permanent disabilities were incurred. This is unusually noteworthy in that machine shops are particularly productive of finger losses. Eye cases showed a marked falling-off both in number and severity. A total of 190 days was lost on account of accidents.

A fully equipped dental department is maintained under the supervision of a dentist who spends one hour a day at the plant. Besides the corrective work done by the dental department, propaganda in the form of instruction and literature is furnished to the employees. During 1919, 1506 mouths were examined and charted. Ninety-six per cent. of these cases needed dental service. The approximate cost of maintaining this service was about $1.12 per employee. The estimated saving to the company on extractions alone is given as approximating $2200 in production.

The work of the social service department is grouped under six headings: (1) follow-up of absences; (2) assisting workers in financial matters; (3) assisting workers in settling family or other difficulties; (4) co-operation in the work of the Mutual Aid Society; (5) furnishing legal aid and advice in buying homes; (6) aid to those desiring to become citizens. Included in these duties of the social service department is the maintenance of a restaurant.

The possibility of obtaining absence rates to serve as a barometer of the hygienic conditions in a department is complicated by such factors as age of employees, sex, unsatisfactory home conditions, diet, and nationality.

In this particular plant the American workers had a lower absence rate due to illness than any other nationality. — C. H. Paull.

Plant Hospital of the Goulds Manufacturing Company. *H. G. Meacham.* Mod. Med., Sept., 1920, 2, No. 9, 608. — A high order of industrial production demands the speedy restoration of an injured or sick workman. Heretofore, careless and crude methods of attending to injuries, by causing infection, have done much harm. By way of contrast with these earlier and cruder practices, the writer describes a hospital erected in 1919 by the Goulds Company. A floor plan of the building is shown, and two photographs and details are given of the method of recording and reporting accidents, etc. — G. E. Partridge.

An Industrial Dental Dispensary. *H. M. Brewer.* Mod. Med., July, 1920, 2, No. 7, 492–494. — The work of the dental dispensary in the National Cash Register Company includes first-aid treatment, gum treatments, prophylaxis, extraction of diseased teeth and roots, X-ray diagnosis, temporary fillings, consultation and advice. Besides the actual dispensary work, literature on the care of the teeth is distributed among employees, and illustrated lectures are furnished from time to time. There is no attempt to provide restorative dentistry, although all the employees whose teeth are examined are furnished with charts indicating the work which should be done. In speaking of the return which this work brings to the company, the writer indicates that there is no quantitative measure of increased efficiency or improvement in regularity of attendance. In quoting several cases, however, he is able to show that the efficiency of the worker is retarded not only through disturbances easily identified with defective teeth but also through more remote disturbances, such as rheumatism, which at times have their original cause in the condition of the mouth. One case of arthritis in the right shoulder was satisfactorily treated by the extraction of several teeth.

A record of the work of the dispensary at Dayton for the year 1919 includes the following: examinations, 1777; prophylaxis, 1726; extractions, 1685; first-aid treatment, 1173; gum treatments, 430; temporary fillings, 94; X-rays, 76; consultations, 166; miscellaneous,

1183. This work was performed by two dentists. One of the most successful features of the work has been the close co-operation between the medical and the dental departments. At the present time an active campaign in oral hygiene is being carried on for the children of employees. These children are encouraged to attend talks on health habits given at Saturday morning meetings. The teeth of these children are also examined. It is the feeling of the writer that an adequate appreciation of dental hygiene can be inculcated satisfactorily only by beginning with children of the school age. — C. H. Paull.

How Armour & Company Supply Dental Service. *Louis P. Cardwell.* Hosp. Management, April, 1920, 9, No. 4, 64. — The scope of work in the dental department of Armour & Company is advisory, educational and prophylactic. Emergency work is treated as conditions indicate. Advisory work consists of a thorough examination of mouth and teeth, with suggestions as to proper treatment. Educational work consists of explaining to each patient the details of his case. Especial emphasis is laid upon prophylactic and correctional treatment to restore the mouth to a clean, healthy condition. — L. A. Shaw.

INDUSTRIAL NURSING

The Public Health Nurse in Relation to the Modern Industrial Hygiene Movement. *W. Wright.* Pub. Health Nurse, June, 1920, 12, No. 6, 520–525. — There is now some degree of common belief regarding the purpose, methods and standards of public health nurses. As to industrial hygiene, it seems that the notions are more vague. The majority of industrial nurses at the present time are "surgical dressers and dispensers of pills." Health in industry, however, depends upon various factors, many of which must come under the control of the industrial nurse — such factors as the subtle effects of all bad working conditions, poor lighting, inadequate ventilation, faulty posture, fatigue, lack of recreation, improper nutrition, worries, fears, congenital defects, tuberculosis, venereal disease and other infections. The conditions at present are bad; we have exploited our people in the industrial life; there is great loss from sickness; and there is a great amount of work to be done to make conditions right. The opportunities for preventive measures in industrial life are many and great, and the nurse will normally take a large part in the work of reform. Much of the progress already made in industrial hygiene is due to the nurse and it will be the same in the future. The capacity for usefulness of an industrial nurse will depend upon her personality, her technical training, her vision and imagination, and upon her willingness and eagerness to grow. One of the most vital functions of the industrial nurse will be teaching, and this makes large demands on ideals and training. — G. E. Partridge.

The Factory Nurse and Industrial Supervision. *W. Pryll.* Zentralbl. f. Gewerbebyg., June, 1920, 8, No. 6, 107–109. — The latest report of the Prussian Industrial Council recognizes fully the value of the work of the industrial nurse, but leaves open the question whether industrial nursing is to be a permanent institution, or is only a war measure — to disappear now that the chief motive for its introduction, the presence of a great number of women in industry, is no longer existent. The writer of the article holds the view that this work ought not only to be maintained, but to be extended and gradually brought under legal provision and given state backing. For Germany's work of reconstruction, sound men are needed and the need and the opportunity for prophylactic sanitation are greater than before the war.

The place of the factory nurse is in the shop. Here her work is a broad and complex one. It includes the sanitary protection of the workers and attention to social problems that arise in the factory. The nurse must take part in the work of overcoming specific dangers to health, and in the periodic medical inspection and the like that must be carried on. Tuberculosis and syphilis and other sources of contagion must be kept under control. The importance of the work of the industrial nurse creates a problem of selection of personnel for the work. Industrial nursing is rather an art than a science, and much depends upon the qualities of the nurse. Also she must be free from too much dependence upon employer or worker for the security of her position, and this is one of the reasons why the work needs state backing. The form which this state control or aid shall take is a matter for later consideration, but in some way industrial nursing must become a part of the

whole system of industrial supervision. — G. E. Partridge.

How the Factory Nurse Helps the Employment Manager. *Samuel N. Comly.* Factory, Sept. 1, 1920, 25, No. 5, 694–695. — This is a brief statement of the procedure followed in looking up absence at the Russell, Burdsall and Ward Bolt and Nut Company's plant. After the workers arrive in the morning, it is the duty of the foreman to take all time cards from the "out" rack. These cards are sent to the employment department. In the employment department is an "absence investigated" card for each worker. From the absence investigated file are taken the cards which correspond to the time cards of the absentees. After noting on the cards any reasons for absence offered by the foreman, they are turned over to the nurse for investigation. The nurse investigates the absence, stating briefly on the card the resnlt of her look-up. She also makes a fuller report in triplicate, one copy going to her file, one to the employment department's file, and one to the foreman. By this method information flows freely between the foreman, the employment department, and the medical department, making full co-operation possible. — C. H. Paull.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

Industrial Survey in Selected Industries in the United States, 1919. Preliminary Report. Prepared under the supervision of *Allan H. Willett.* U. S. Bur. Labor Statis., Bull. No. 265, May, 1920, pp. 509. — This bulletin contains a summary report on the wages and hours of labor in the following industries: automobiles; paper boxes; brick; cars; chemicals; cigars; men's clothing; women's clothing; coal; confectionery; electrical machinery; foundries; furniture, glass; hosiery and underwear; iron and steel; leather; logging; lumber; machine tools and other machinery; millwork; overalls; paper and pulp; pottery; rubber; silk; and typewriters.

Since this pamphlet consists largely of elaborate and very numerous tables of average hours worked per week day and earnings per hour worked in the various industries classified by sex and occupation of employees, pay-roll period and locality, no attempt will be made to review its contents in detail. The interested reader is referred to the original. — K. R. Drinker.

Some Observations on Bobbin-Winding. *S. Wyatt.* Industrial Fatigue Research Board, Report No. 8. Textile Series No. 2. His Majesty's Stationery Office, London, 1920, pp. 40. — "Since this investigation was restricted to the bobbin-winding department of a single mill, any conclusion set forth must necessarily relate to the conditions existing in this mill, and not the industry as a whole. The chief points observed in the course of this investigation are:

"1. The conditions of labour were found to be generally satisfactory and with the possible exception of the distribution of the reduced number of working hours, it is concluded that these conditions were not calculated to favour the development of unnecessary fatigue. Possibly an unbroken working spell of four and a half hours is too long, but the provision of tea at about the middle of the afternoon spell is beneficial and is a practice worthy of a wider adoption.

"2. The ventilation of the winding room was not satisfactory because of the inadeqnate movement of the air. As a consequence, the cooling power of the air was insufficient, and the stimulating effect of air having a moderate and variable rate of movement was entirely lost, so that although the temperature and humidity were not unduly high, it is probable that the conditions accelerated the development of fatigue in the operatives.

"3. Defective organisation, which resulted in the arrival of the ring yarn to the winders being delayed, not only diminished output, but also tended still further to reduce the efficiency of the winders, either by producing loss of interest in the work, owing to the annoyance or worry caused by the necessity of spending unremunerative time at the mill, or by producing unnecessary fatigue, owing to the adoption of a physiologically uneconomic rate of working in the effort to make up for lost time.

"4. Certain improvements in the design of the machinery used in bobbin-winding appear to be necessary in order to decrease the nature and extent of movements made by the operatives under the existing conditions. These improvements should also include, if possible, the automatic performance by the machine of cer-

tain operations at present included in the manual operations of the winders. Greater efficiency could be secured if the organisation of the work relieved the winders of the necessity for performing the heavy auxiliary operations involved in the process of bobbin-winding.

"5. Considerable individual differences in efficiency were found to exist. These may be due either to individual differences in ability and method employed, or to differences in temperament. Further standardization of the methods of work is possible, but not necessarily advisable, since the human organism itself does not exactly conform to a rigid type. The best method for one individual is not necessarily the best for all. Each operative exhibits a natural tendency to discover and adopt a method which, to him, is the most suitable, but there are differences in ability to discover this method. Careful selection of the workers, and individual rather than group training, is necessary in order to secure maximum efficiency.

"6. A noticeable and very satisfactory feature was the good feeling which existed between the management and operatives in the winding department of this mill. A general state of contentment and industry prevailed which was chiefly due to the tact and sympathetic behaviour of the overlooker." — C. K. Drinker.

INDUSTRIAL PSYCHOLOGY AND INDUSTRIAL MANAGEMENT IN ITS HEALTH RELATIONS

Proceedings of the Twenty-Eighth Annual Meeting of the American Psychological Association, Cambridge, Massachusetts, December 29, 30, 31, 1919. *H. S. Langfeld.* Psychological Bull., Feb., 1920, 17, No. 2, 33–82. — Several of the papers read at this meeting are of interest from the standpoint of industrial hygiene. J. E. Anderson reported studies of physical and mental work in which circulatory changes in the arm were tested by means of the Lehmann arm plethysmograph. Nearly a score of the papers presented dealt with the problem of intelligence and closely related subjects. F. A. C. Perrin presented some results of an investigation of the relations of motor tests to estimates of character, mental test scores and scholarship grades. He concludes that motor ability is not general, but definitely localized; that a complex motor performance is not to be explained primarily in terms of a number of specific motor functions; that the type of intelligence measured by mental tests and by university grades fails to correlate in any significant way with any of the motor tests (tests of elementary processes), but factors best described as intelligence factors contribute primarily to superior ability in complex motor tests. The assumption that there are general traits of character which can be used as explanatory principles in the analysis of motor ability is justified only in part.

W. V. Bingham reported on group tests, and there were several papers dealing with the relation of tests to school and college work. F. L. Wells contributed an important investigation of the intelligence quotient of patients suffering from mental troubles. The median in 102 cases was found to be 88, "entirely compatible with normal self-maintenance." An intelligence quotient as high as 119 was noticed in adults conspicuously incapable of self-maintenance. The conclusion is that above a necessary minimum the value of intelligence for general adaptation depends greatly upon the support of other factors in the personality. Intelligence scales measure essentially ability to deal with ideas, as distinct from ability to deal with things or other persons. Psychotic breakdowns are essentially failures of adjustment to the social environment. A. F. Bronner maintained that variations in mental equipment are not indicated by an intelligence ratio; that group testing has very specific values, but that it also has distinct limitations. The function of clinical psychology is largely that of individual diagnosis. Extremely varied special problems are presented to the clinical psychologist, which require special study, presumably, by means of special tests.

H. L. Hollingsworth reported on the psychology of the functional neuroses, F. Mateer on the psychological detection of syphilis, asserting that certain characteristic findings during psychological tests make possible a diagnosis of syphilis. The problems of the clinical psychologist were discussed by D. Mitchell, and the use of psychological tests in the training of teachers by E. A. Kirkpatrick. Psychological tests of aviators, as used in the A. E. F., were discussed in a paper by F. C.

Dockeray and S. Isaacs, and the ocular functions as related to the look-out and signal service of the Navy by C. E. Ferree and G. Rand. What industry wants and does not want from psychology was the subject of a paper by E. Frost, and recent developments in trade test theory, a paper by A. Kornhauser and B. Ruml. Two other papers, one on the extension of rating scale theory and technique, by D. G. Paterson and B. Ruml, and the other on an important constant error in psychological rating, by E. L. Thorndike should be mentioned in the present connection. — G. E. Partridge.

Movement toward Vocational Psychology in Germany. *W. Stern.* Ztschr. für pädagogische Psychologie und experimentelle Pädagogik. March–April, 1917, 18, Nos. 3–4, 156–158. — Stern records that the movement of interest toward vocational psychology has recently been very rapid in Germany. The military department has taken the lead and has made a thorough application of results previously obtained by psychologists. In the industries also there is a wide interest in practical psychology and many tests that have been used in the service — in examining aviators, to take a single example — have now become available in testing industrial groups. Tests are being made in Leipzig in the printer's trades with reference to measuring the special abilities used in these occupations. The paper contains information about recent developments in the teaching of practical psychology. — G. E. Partridge.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

The Westinghouse Lunch Club. *W. W. Rodgers.* Mod. Med., Sept., 1920, 2, No. 9, 610–611. — In recent years manufacturing plants all over the country have opened cafeterias for their employees, giving wholesome food at a low price and served under sanitary conditions. Research work has shown that many workers are subnormal from eating unwholesome food, even the home lunches being often lacking in nutritional qualities. These conditions the cafeteria has helped to change, and it has also done away with the small restaurants that spring up about large factories.

Recently the Westinghouse Company opened the largest industrial restaurant in the world. The building has a seating capacity of more than 3200. The first floor is given over to women employees who carry their own lunches; there is a cafeteria for men and women on the second floor; and the third floor is occupied by a large dining room and an auditorium. The building has many new features — such as ramps instead of stairways — and both kitchen and dining rooms have been equipped with sanitary, labor-saving devices that enable a comparatively small force to serve hundreds of people in a short time. The lunch club is not self-sustaining, but is run at a loss in order to furnish food to employees at the lowest possible price. — G. E. Partridge.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

New York State Workmen's Compensation Law with Amendments, Additions and Annotations to August 1, 1920. Prepared by the Bureau of Statistics and Information, New York State. Pp. 114. Court Decisions on Workmen's Compensation Law, July, 1919–June, 1920: Subjects other than Constitutionality and Coverage. New York State Department of Labor, Special Bulletin No. 98, July, 1920, pp. 113. Comparison of Workmen's Compensation Laws of the United States and Canada up to January 1, 1920. *Carl Hookstadt.* U. S. Bur. Labor Statis., Bull. No. 275, Sept., 1920, pp. 140. Decisions of Courts and Opinions Affecting Labor, 1918. U. S. Bur. Labor Statis., Bull. No. 258, Dec., 1919, pp. 239. New York State Labor Law with Amendments, Additions, and Annotations to August 1, 1920. Prepared by the Bureau of Statistics and Information, New York State, pp. 191. New York Labor Laws Enacted in 1920. New York State Dept. Labor, Special Bull. No. 99, June, 1920, pp. 93. — The above titles are listed for the information of persons interested in labor and workmen's compensation laws. — K. R. Drinker.

Fee Schedules under Workmen's Compensation. Mod. Medicine, July, 1920, 2, No. 7, 498–499. — After prolonged consideration a new schedule has been established by the Industrial Commission of Ohio affecting medical and surgical fees under the Workmen's Compensation Act. This schedule is of particular interest in that the Ohio Compensation Act is universal and compulsory and all industrial accidents come within its scope. The complete schedule is reprinted. Some of the items are as follows:

Minor injuries (first dressing) day, at office	$3.00
Minor injuries (first dressing) home or hospital ..	5.00
Minor injuries (first dressing) night, 9 P.M.–6.30 A.M	7.00
Minor injuries (subsequent dressing) at office....	1.50
Removal of foreign body (eye) ordinary........	2.00
Herniotomy — single (including after care)	75.00
Shoulder dislocation (including reduction and subsequent treatment)........................	35.00
Clavicle dislocation (including reduction and subsequent treatment)........................	50.00
Knee dislocation (including reduction and subsequent treatment...........................	50.00
Finger dislocation (including reduction and subsequent treatment).........................	10.00
Fracture — 1 bone of the forearm (including subsequent treatment)........................	50.00
Femur (including subsequent treatment)........	100.00
Amputation — leg at knee or above	75.00 to 120.00
Extraction of foreign body from inside of eyeball, with or without magnet............	50.00 to 75.00
Refraction.........................	5.00 to 10.00

— C. H. Paull.

Amendment to the Wisconsin Compensation Law. Hosp. Management, April, 1920, 9, No. 4, 70. — An amendment to the workmen's compensation act of Wisconsin has made compensable all diseases which arise while the injured employee is performing services growing out of and incidental to his employment. The amendment does not enumerate the particular occupational diseases included in the law, but it is held to be of no importance whether an injury is an accident or an occupational disease. Hitherto if such disease could not be traced to result of accident, compensation was not allowed. — L. A. Shaw.

Lead Poisoning from the Standpoint of Insurance Legislation. *Hans Betke.* Concordia, July 1, 1920, 27, No. 13/14, 133–136. — The author discusses in some detail the incidence of lead poisoning in some industries, the relative importance and medical difficulties in the diagnosis of the chronic form of the poisoning, the symptomatology of the disease, and the large number of industries concerned. He then shows that the existing accident insurance laws allow small fractions of the total lost earnings to men who are totally disabled by lead poisoning, and that such pensions are available only after payment of premiums for 200 weeks. Accidents are much better compensated, and compensation is available at once. Although England and Switzerland include lead poisoning with accidents in industries, he cites opinions and discussions to show that there are difficulties in this method and that lead poisoning should be classed as an industrial disease. Lead workers must be protected from becoming public burdens.

Statistical studies will be needed; lead poisoning and certain infectious diseases must be made reportable. It may be asked to have lead poisoning included in the present accident provisions as have been poisoning from nitro-compounds and from war gases. Since this is only a temporary expedient and would involve similar pleas for such poisons as zinc and mercury a new law on industrial poisons is highly desirable. It should provide for medical treatment, withdrawal from work, pensions until the earning power is re-established, and hygiene in the plants to avoid poisoning. The medical profession should try to eliminate the unfit from lead work. Steps should be taken to get the whole body of physicians more familiar with lead poisoning. — E. L. Sevringhaus.

REHABILITATION OF DISABLED EMPLOYEES

The Law of May 6, 1920, Establishing Public Care for Cripples. *Schlossmann.* Deutsch. med. Wchnschr., July 18, 1920, 46, No. 29, 803. — The provisions of the new law establishing extensive care for all cripples under 18 years of age is discussed at some length by the author. "No one in Prussia shall be crippled, if it is possible to avoid it. No cripple who can be cured or improved shall be denied the possibility of cure or improvement. No cripple who can practice any calling shall remain without means of livelihood. No cripple who lacks care, attention, or medical service shall be denied these. This is the soul, intent and meaning of the law concerning the care of cripples of May 6, 1920." — T. J. Putnam.

Re-Vocational Centers. *Christine R. Kefauver.* Month. Bull., Dept. Health, New York City, May, 1920, 10, No. 5, 119-121. — The great need of the time is production and economy. The new policy of utilizing waste products has resulted in the last quarter of a century in the building up of many important industries. Labor might well follow the lead of capital in this respect and give attention more to the work of salvage — the re-education or reconstruction of the human material which at the present time is largely waste in industry. The greater part of industrial misfits can be traced to physical conditions, of the existence of which, in most cases, the persons afflicted are unaware. Labor maintains, and with some truth, that physical examinations have been used in the past to the disadvantage of those who were examined, but this is no reason why labor should deprive itself of the benefit of so valuable an aid as physical examination, which becomes more and more important as industry becomes complex and people depend upon the efficiency of one another in their daily work.

Occupational clinics were organized in New York City several years ago for the examination of food handlers, all persons having anything to do with the handling of food being required by statute to be examined at least once a year by the physicians of these clinics or by their private physicians. The general good of such work is obvious and, in much the same way, we may be justified in demanding that the lives of our citizens be not unnecessarily endangered by fellow-workers who suffer from physical defects. The movement toward improvement in this direction ought to originate in the unions, and the main requirement is for the establishment of vocational centers in which workers, shown to be unfit for the tasks in which they are engaged, could be taught other trades in which their handicaps would not be a drawback. These re-vocational centers could also take over the training of victims of industrial accidents who might be unable to return to their original occupations.

In regard to the danger that physical examinations may be used to the detriment of the worker, the method adopted by the Division of Industrial Hygiene of the New York City Department of Health is offered as a solution. Lectures on health are given in the shops, sometimes in the noon hour, sometimes in the employer's time. The advantages of physical examination are explained and the workers are given opportunity to make application for examination. These examinations are confidential, and the name of the person examined does not appear on the record, unless it is especially requested. If defects are found, the worker is advised how to correct them and what processes in the work, if such exist, are responsible for the troubles. — G. E. Partridge.

Putting the Ex-Consumptive Back on the Job. Bull. N. Y. Tuberculosis Assn., Inc., Oct., 1920, 1, No. 7, 1-4. — "The all too frequent recurrence of tuberculosis, among those whose disease has been apparently arrested by sanatorium or other treatment, has long been a problem calling for solution. The commonest cause of such relapses has been the return from ideal sanatorium life to the same unfavorable working and living conditions under which the disease first started. The sudden change from absolute rest to a full day's work — without a hardening process — is almost equally dangerous. The situation must be met by the gradual utilization of occupation therapy and vocational training, at the sanatorium in the country, followed, in town, by industrial rehabilitation at a sanitary workshop and by improvement of home conditions.

"The Federal Board for Vocational Education, having a large number of ex-service men suffering and recovering from tuberculosis, and recognizing the above facts, proposed to the National Tuberculosis Association and the New York Tuberculosis Association that a workshop for such industrial rehabilitation be established in New York City.

Model Workshop in Long Island City

"The New York Tuberculosis Association, after preliminary investigation of suitable trades and the best location, opened, on June 15, 1920, a model workshop in Long Island City for the training, under ideal sanitary conditions, of arrested cases of tuberculosis. It is incorporated under the name of the Reco Manufacturing Company, and is under the direction of an active committee of public spirited business men, headed by Mr. Fred M. Stein, who established some years ago the Altro Shop, the first successful workshop of this kind for the needlework trades.

"The shop has now been running five months. It is situated in the newly developed manufacturing section of Long Island City, in the Borough of Queens. The building is new,

has light and air on all sides, is up to date in every respect, and is within five minutes' walk of the subway from Manhattan. The plant is on the third, and highest, floor of the building. The workrooms have large windows on all sides, and there is a maximum of air and sunlight for its occupants. The shop is equipped with hygienic and sanitary fixtures.

Admission Requirements

"At present only men with arrested or quiescent tuberculosis and negative sputum are received by the Reco Manufacturing Company. The men now under training are largely ex-service men, but civilians who are suitable patients and anxious to take up any of these trades will be accepted if they are prepared to spend the full period of apprenticeship. They should apply or be referred to the Manhattan Office, at 10 East 39th Street, at 9 A.M., daily, except Sunday. Properly qualified visitors are always welcome and arrangements for such visits will be made on request.

Medical and Social Supervision

"All applicants are subjected to a thorough medical examination before admission. Close and exhaustive histories of each patient are taken and the effects of the work carefully noted; but, it is a workshop and not a sanatorium, rest-camp or health school. Care is taken that the medical and social work, while thorough, is not obtrusive. All examinations are made in Manhattan at the offices of the New York Tuberculosis Association. After a man is admitted to the shop and has started training, he is re-examined at the end of the first week and later once a month to determine the effects of the work. If his condition is at all questionable he returns oftener. In case of a relapse men are returned to the sanatoria or hospitals for proper care. Only one such case has occurred so far. Close supervision is kept of all men under training by means of these periodic examinations, and also by the trained nurse, who is at the shop several hours daily and takes temperature and weight of each man weekly.

"The amount of work that each man is first allowed to do, as well as any increase of it, are specifically prescribed by the medical officer. A first aid kit is kept at hand; the nurse's room has a couch and emergency facilities in case of need.

"It is intended that the shop be like any other well-conducted factory, with the added fundamentals of teaching non-injurious, well paying trades, by part or full time training under strict medical supervision, and under the best obtainable hygienic surroundings. A cafeteria lunchroom has been installed and nourishing meals are served at cost. A rest room will be provided on the roof, protected and furnished with reclining chairs, tables and reading matter. The men are encouraged to rest after their lunch and work periods.

"The home conditions of the men receive equal attention. Much of the good work may be undone at the home, where bad conditions beyond the patient's capacity to remedy may be present. A trained social worker investigates and visits regularly the home of each man. The benefit of her experience and advice is freely given; the best use of the rooms and resources available are pointed out. Family cares and worries are cheerfully shared; children in need of building-up are cared for; the advice of the physician is emphasized and followed up.

Trades Taught

"The trades selected to be taught at the shop are watch repairing, jewelry manufacturing and cabinet making; these were chosen only after careful investigation. They are deemed most desirable because not injurious to the lungs nor especially fatiguing. Workmen in these trades are very well paid and there is a great demand for men skilled in these particular occupations. The instruction is carried out by experienced men who are experts in their respective trades. According to conservative experience, the present wages men may earn in these trades are from forty to seventy-five dollars a week.

"When the students in the shop have gained enough skill to do marketable work they are paid wages on a piece-work basis. The skill that some of the men have developed has been surprising; without any previous mechanical experience, some have become proficient enough to make salable articles within two and a half months on only part time training.

Ideals in View

"It is the intention to make the city model workshop the last step in the training and treatment of the tuberculous. Schools for pre-vocational training in certain sanatoria (Loomis, Otisville and Gaylord Farm) are conducted by the New York Tuberculosis Association, where

preliminary instruction is given to the sanatorium patient and he is prepared for transfer to the workshop as soon as his physical condition warrants. In this way the harmful gap of uncertainty following discharge is bridged. A record of his work at the sanatorium is kept and forwarded to the workshop. This prevocational training decreases the amount of time a patient will have to stay in the sanatorium, through the curative effect that it will have on his disease, provided he is interested in the trade. It also shortens his time at the shop because he enters with a grounding in his trade, experience with the special tools required, and is therefore ready for advanced instruction and will begin receiving wages all the sooner.

"It is the aim to gradually increase the working hours of the man with arrested tuberculosis until he can do a full day's work; to teach him a well-paid trade, keeping him all the while under medical observation until his ability and physical condition warrant discharge; finally, to find him a suitable position. Thus trained, hardened and re-established in life, his chances of again falling a victim to tuberculosis will be minimized, and he can take his place in the community as a healthy, self-respecting, self-supporting citizen."

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II FEBRUARY, 1921 NUMBER 10

CONTENTS

GENERAL

ECONOMIC ASPECT OF INDUSTRIAL HYGIENE. *Bernard J. Newman.* Indust. Management, Oct., 1920, 60, No. 4, 271–273. — The writer points to the fact that there is a definite connection between the development of industrial relations and problems of public welfare. Because society has recognized that industry is a source of certain health and accident hazards it has tended more and more to place remedial responsibility upon the source of the hazards. During the early development of medical departments there was a tendency to pay small salaries to physicians. This led to a great deal of perfunctory medical work. Later developments, however, have shown industry the value of obtaining medical service of a higher standard that would not only look after the routine of the medical department, but would have the capacity and willingness to carry on research and assist in developing policies. The writer feels that the selling qualities of this higher type of industrial hygiene depend largely upon their ability to show a "profit for production."

Industrial hygiene implies that "factory working conditions should conform to the laws of health." Industrial hygiene would, therefore, safeguard the worker from injurious consequences attendant upon his work. This would definitely connect the medical department with all problems of sanitation, the protection of the worker against the "dangers of dusts, gases, fumes, excessive heat or cold, abnormal temperature and humidity, fatigue, excessive glare or light intensity or gloom."

The writer goes on to point out that one of the great factors in working efficiency is the health of the individual. Those things which interfere with health break up the balance which determines the individual's complete effectiveness. Where a group of adverse conditions exist there develops a complex of disturbances which may or may not bear a definite relation to the elements. Industrial losses extend far beyond mere interference with speed of production where unhygienic factors are involved. There are problems of intermittent employment due to accident and ill health; labor turnover tends to increase; where skilled or semi-skilled labor is employed the cost of training and the hazard of employing new

workers is augmented. Danger goes even a step further and exhibits itself in low morale. Where the worker is physically unhappy he becomes mentally unhappy, and may show signs of sullenness, lack of co-operation or soldiering.

In conclusion the writer states "it is a misconception to attribute the cost for the establishment and maintenance of hygienic working conditions to the debit account. They are part of the investment, and if carefully supervised yield financial returns through the increased efficiency and sustained production of the workers." — C. H. Paull.

Sickness and Absenteeism during 1919 in a Large Industrial Establishment. *Dean K. Brundage.* U. S. Pub. Health Ser., Pub. Health Rep., Sept. 10, 1920, 35, No. 37, 2143–2154. — This is the report of the experience of an eastern manufacturing company employing 6700 workers. This concern follows up absence after the second day. It pays sickness and non-industrial accident benefits to workers incapacitated for more than seven consecutive days. The working time lost from all causes totalled more than 115,000 working days. In terms of lost time per employee this means $17\frac{1}{10}$ working days. The following table shows the per cent. of working time lost by months classified according to causes:

Month	All Causes of Absence	Sickness	Personal Reasons	Industrial Accidents	Non-Industrial Accidents
January	5.39	1.51	3.50	0.28	0.10
February	5.14	1.64	3.27	0.17	0.06
March	6.27	2.13	3.88	0.20	0.06
April	6.95	2.54	4.27	0.02	0.03
May	7.69	1.78	5.65	0.16	0.10
June	4.70	1.60	2.90	0.10	0.10
July	4.72	1.39	3.10	0.16	0.07
August	5.13	1.51	3.34	0.19	0.07
September	5.71	1.79	3.77	0.14	....
October	5.80	1.80	3.70	0.20	0.10
November	5.20	1.67	3.29	0.21	0.03
December	6.03	2.01	3.82	0.15	0.05
Year	5.65	1.78	3.63	0.18	0.06

A study of Chart 1 given in the discussion as well as of the correlation figures indicates that there is probably a relation between the rate of absence and the sickness rate, though the relation between the sickness rate and the rate for other factors shows little correlation. — C. H. Paull.

Training for the Higher Industrial Supervision Service. *Jacobi.* Zentralbl. f. Gewerbehyg., Feb., 1920, 8, No. 2, 25–28. — Rasch, in a previous paper, has discussed the preparation for the industrial supervision service and has emphasized and favored the development of officials through practice. Candidates, after the completion of technical studies, act for two or three years as assistants in industrial supervision work, and then take the state examinations as required. This is similar to the Prussian plan for the training of chemists.

Jacobi takes exception to a considerable part of this program. We must guard against placing a too high estimate upon practical work. The usual shop work is apt to be beside the point. Also, at the present time, too much scientific training that is useless is given, while on the other hand much is omitted that is important and of direct value — such branches, for example, as industrial hygiene, and the legal subjects that enter into industry.

A suitable course of training for the higher industrial supervision and inspection would include, besides the purely mechanical and technical sciences, hygiene, accident prevention, economics, and law subjects. Some of the higher mathematics can be omitted, and other less practical work. A year and a half may be given to practice work in industrial supervision. Another half year should be devoted to the learning of the methods of other related administrative work such as various city and district departments. The course should so be arranged that it would be easy to change afterwards to other engineering professions, if for any cause such a change be desirable. The whole plan is flexible, and it is recognized that there is no one single way of educating for the professional work under discussion. What is wanted is the best trained personnel, but at the same time it is desirable to have men in the work as early as they are able to give good service. — G. E. Partridge.

Chronicles of Social Hygiene. *A. Elster.* Öffentliche Gesundheitspflege, April, 1920, 5, No. 4, 132–143. — This report, which is a review of current topics of social hygiene, contains a brief section on industrial poisons — a subject which, although lying outside the field

of infections which the writer is especially reviewing, needs, he thinks, to be considered in the same connection. On January 27 a new regulation was passed respecting processes in the preparation of lead colors and other lead mixtures. The order contains twenty-seven paragraphs in which the requirements are more sharply defined. On the same date there was a new interpretation of the law regarding lead working, and an order for medical inspection and supervision of the health of lead workers.

Francke has given a summary of the most important results contained in the annual report of the Prussian department of industrial supervision. The point is made that the effects of industrial poisons are increased in an extraordinary degree by poor working conditions and regulations, and are greatly lessened by proper care. As an instance is mentioned the dangerous work in dinitrobenzol, a work in which the good facilities of the large-scale producer have greatly reduced the hazards, while some makers, having so many cases of aniline poisoning as a result of inferior nitrification apparatus, have abandoned the work altogether. In one case, a war plant, established and conducted under poor conditions, had many severe cases while a well-conducted plant in the same district had only one or two light cases in a month. — G. E. Partridge.

SYSTEMIC OCCUPATIONAL DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Cancer, with Special Reference to Sarcoma in its Relationship to Trauma. *Raphael Lewy.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 238–244. — In 26,389 examinations there were found thirty-seven malignant tumors attributable to trauma. Sarcoma may develop early in life and develop without trauma. On the other hand, trauma may be the primary cause in its development, or may be the activating factor in its very rapid growth. Such trauma need not be severe nor disabling. It is sometimes referable to muscular exertion and not to direct force.

The interval between infliction of the trauma and the appearance of the first sign of sarcoma may be a week up to two years. Sarcomata of the joints, especially of the knee, have in their early stages been faultily diagnosed as rheumatic conditions. — Barnett Cohen.

CENTRAL NERVOUS SYSTEM

Need of Recognition of and Better Treatment for Mental and Nervous Injuries. *Francis D. Donoghue.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 272–277. — "My sole desire at this time is to call your attention to the need of calling to the assistance of the boards [workmen's compensation] men competent to diagnose and advise treatment in this group of cases, and through them to encourage the further standardization of this group of cases. The present method of handling them, by exerting constant pressure from the insurance physician, insurance adjuster, or compensation commissioner, is not always a success." — Barnett Cohen.

NEUROMUSCULAR SYSTEM

Twisters' Disability in the Cotton Trade; Commonly Known as Twisters' Cramp. *J. C. Bridge.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1919, pp. 69–72. — The disability which occasionally attends the operation of twisting in the cotton trade produces a condition of the hand which either entirely prevents the workman thus affected from following this occupation, or compels him to work under a disability which precludes him from earning a wage commensurate with previous earnings. An outline of the operation of twisting is given and a discussion of the complex muscular action which this work entails.

The symptoms of twisters' cramp are: pain, generally referred to the base of the thumb, rarely extending up the arm; tenderness of the muscles; sometimes, swelling at the base of the thumb. Actual cramp is rare. Weakness and loss of power of the thumb is the prominent symptom, rendering impossible the final rolling over of the twisted ends of the thread in such a way as to produce a firm junction ("unable to finish twirl"). Fifty per cent. of the men examined showed an unusual flattening or apparent wasting of the thenar eminence (ball of thumb) or small muscles of the thumb.

The author believes the condition to be due to a widening in the controlling mechanism of the central nervous system plus a local chronic inflammation of the muscular tissue. — L. A. Shaw.

Elimination of Carbon Monoxid from Blood after a Dangerous Degree of Asphyxiation; Therapy for Accelerating Elimination. *Y. Henderson* and *H. W. Haggard.* Abstracted as follows from Jour. Pharmacol. and Exper. Therap., Aug., 1920, 16, No. 1, 11, in Jour. Am. Med. Assn., Oct. 9, 1920, 75, No. 15, 1024. — "It is shown by Henderson and Haggard that during the development of carbon monoxid asphyxia there is vigorous hyperpnea, and that thereafter, probably owing to deficient oxygenation and other causes, there is a diminished production of carbon dioxid. As a result of deficiency of carbon dioxid in the blood, asphyxiated animals when restored to pure air exhibit for half an hour or more a very marked depression of breathing. The rate of elimination of carbon monoxid is correspondingly slow. The condition of tissue asphyxia is thus continued, although the body is surrounded by fresh air. It is suggested that this postgassing period of continued asphyxia may be of critical importance in inducing subsequent structural degenerations and functional impairments. Its abbreviation is therefore an important object both for therapy and prophylaxis. Oxygen inhalation during this period has only a slight effect; it is not adequately inspired. Inhalation of carbon dioxid diluted with air has an immediate effect. It augments breathing and thus hastens the elimination of carbon monoxid. Inhalation of oxygen plus carbon dioxid is far more effective than either gas alone; for the augmented breathing allows the oxygen to effect a rapid displacement of carbon monoxid from the blood. Functional restoration is correspondingly accelerated." — M. C. Shorley.

Histopathology of Carbon Monoxid Poisoning. *R. M. Stewart.* Abstracted as follows from Jour. Neurol. and Psychopath., Aug., 1920, 1, No. 2, 105, in Jour. Am. Med. Assn., Nov. 20, 1920, 75, No. 21, 1455. — "The histologic appearances described by Stewart confirm the observation that in fatal cases of gas poisoning the brunt of the damage to the tissues falls on the central nervous system. The evidence is in favor of the view that carbon monoxid exerts its influence in two ways: (1) indirectly, by altering the coagulative power of the blood, and diminishing the oxygen supply to the tissues; and (2) directly, by a specific action on the parenchymatous elements of the nervous system." — K. R. Drinker.

Tumors of the Uropoietic System Observed in Men Working in Chemical Factories. Their Relation to the General Pathogenesis of Tumors. *R. Oppenheimer.* Abstracted as follows from München. med. Wchnschr., Jan. 2, 1920, 67, No. 1, 12–14, by S. Amberg in Chem. Abstr., Sept. 20, 1920, 14, No. 18, 2815. — "The author suspects in various cases, as possible producers of tumors, chiefly of the bladder, aniline, benzidine, aniline and naphthylamine, aniline and benzene and toluene, benzidine and aniline, benzidine and tolidine, aminonaphthol and cresoldicarboxylic acid, naphthylamine and cresoldicarboxylic acid. Twenty cases were observed. The tumors were papillomas and cancers. Tumors may occur in people who are not directly concerned with the manufacturing, but who work near by. It takes ten to twenty years to produce the tumors. Several other phases of the problems are discussed." — W. O. Fenn.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Mechanism of the Poisonous Effects of the Aromatic Nitro-Compounds, together with a Discussion of the Respiratory Problem of Animal and Plant Cells. *W. Lipschitz.* Abstracted as follows from Zeit. physiol. Chem., 1920, 109, 189–258, by C. L. E. in Physiol. Abstr., Sept. and Oct., 1920, 5, Nos. 6 and 7, 327–328. — "Living cells can remove two atoms of O from insoluble nitro-compounds, such as *m*- or *o*-dinitrobenzene or dinitrotoluene. In this (endothermic) reduction the yellow *m*-nitrophenylhydroxylamines are formed; these are powerful poisons, the administration of which leads to morphological blood changes as well as to chemical alterations such as formation of met-Hb. Any condition which hinders cell respiration, such as impairment of cell structure, narcotics, HCN, high tempera-

ture, or removal of the thermostable co-ferment by washing, at the same time removes the power to form nitrophenylhydroxylamines; *m*-dinitrobenzene was employed as a sensitive reagent for the measurement of respiratory power in experiments on mammalian lungs, kidneys, liver, gastric mucosa, and muscle; also on yeast, yeast maceration juice, and germinating plant cells. Support was given to Meyerhof's theory of the identity of the co-enzymes of respiration and fermentation, by the observation that when boiled muscle or yeast juice was added to muscle which had been inactivated by washing, the reducing power was restored. Under anaerobic conditions muscle reduced more promptly, indicating that the nitro-body acts as a true hydrogen acceptor in the respiratory process. For estimating the intensity of respiration — *e. g.*, in different species of animals — the amounts of nitrophenylhydroxylamine formed were estimated spectroscopically by finding the time taken to form met-Hb when the filtrates were treated with Hb. In the formation of the toxic nitrophenylhydroxylamines we have an example of an individual factor in toxic action; a second is the detoxification by conversion to nitranilines; while a third factor is the sensitiveness of various tissues to the drug, in the present case the blood being most sensitive." — Reid Hunt.

Transfusion in Nitrobenzene Poisoning. *S. Hindse-Nielsen.* Abstracted as follows from Ugeskrift for Laeger, Sept. 9, 1920, 82, No. 37, 1157, in Jour. Am. Med. Assn., Nov. 27, 1920, 75, No. 22, 1530. — "The artificial oil of bitter almonds, or nitrobenzene, is occasionally taken, or used by mistake for benzaldehyd, but the resulting symptoms are liable to be mistaken for potassium cyanid poisoning. The odor of the breath is the same, but with the latter the complexion is natural while with nitrobenzene poisoning there is intense cyanosis. Early differentiation is important, as transfusion of blood may prove life saving, with nitrobenzene poisoning, as in a case described, while this would be irrational with the other, as the blood is ready to give up its oxygen but the tissues have lost the capacity of taking it up. The stomach must be freely rinsed out with nitrobenzene poisoning, concluding by pouring through the tube 0.5 gm. of calomel, or better yet, a saline purge, as this would prevent absorption. Castor oil, oil, milk, and alcohol must not be allowed, as they help to dissolve the poison further. A warm bath with a cold douche proved extremely beneficial in three cases. Nitrobenzene destroys the erythrocytes, transforms the oxyhemoglobin into methemoglobin, irritates and then paralyzes the central nervous system, and has a dilating effect on the heart." — K. R. Drinker.

Methyl Bromide Poisoning—A Contribution to the Study of the Delayed Action of Poisons. *Fritz Rohrer.* Vrtljschr. f. gerichtl. Med., July, 1920, Third Series, 60, No. 1, 51–59. — Rohrer reports a case of acute poisoning from fumes of methyl bromide which gave a very characteristic clinical picture. A foreman in a chemical factory was brought to the hospital unconscious, with deep inspirations, foam on the lips, pupils widely dilated. Convulsive attacks, affecting especially the muscles of the arms and of the jaws, succeeded each other with constantly shorter intervals until the condition became continuous. The blood flowed readily, was blackish in color, coagulated normally. The differential count gave 40 per cent. mononuclears. There was no abnormality of the red cells. Urine showed albumin, no sugar, acetone, or acetic acid.

The history showed that on the previous day he had twice done some repair work on the methyl bromide apparatus. Nothing unusual was noticed in his condition that day except that he was unusually silent and weary at night. Three o'clock the following afternoon, he was suddenly taken with violent jerking of the left arm; he soon lost consciousness and epileptiform attacks came on at short intervals up to his death within about an hour of the onset of the attack. No bromine or bromine compounds were found in organs or fluids.

Rohrer reviews eight cases in the literature, in four of which there was a history of severe muscular jerkings. A remarkable feature of the poisoning is the long latency of a compound which is rapidly absorbed and which disappears so quickly from organs and fluids that it has never been detected at autopsy. The damage to the central nervous system is profound and more or less permanent. Whether this disturbance takes place primarily in the cells of the central nervous system, or in the ductless glands, causing functional changes in the nervous system, cannot as yet be said. It is even possible that there may be a general disturbance of metabolism resulting in an accumulation of products capable of causing this catastrophic

effect on the central nervous system. The sudden explosion of symptoms reminds one of a fatal anaphylactic shock. — A. Hamilton.

Poisoning with Methyl Bromide and Demonstration of the Substance in the Blood and Organs of Poisoned Animals. *W. Löffler* and *W. Rütimeyer.* Vrtljschr. f. gerichtl. Med., July, 1920, Third Series, 60, No. 1, 60–67. — Methyl bromide is produced in the chemical industry to be used for the preparation of methyl compounds for aniline dyes and of antipyrin. Ten cases of poisoning by methyl bromide have been reported in the literature since 1899, and the authors add another. This was a case of sub-acute poisoning, the patient having complained of discomfort whenever he was employed indoors in the methyl bromide department, but declaring himself perfectly well when he was shifted to out-of-door work. One day during his second period of employment with methyl bromide, he was exposed to fumes in perceptible amount but did not complain, and went on working. Three days later, he was again exposed, this time to a larger amount. The accident occurred in the morning and it was not until he was preparing to leave at the end of the day that he was suddenly taken with dizziness, violent trembling of the whole body, and loss of consciousness. He was seized with clonic and tonic convulsions every five or ten minutes, with jaws locked, hands clenched, opisthotonus, pupils wide, no corneal reflex. These attacks lasted two minutes; then there was sudden relaxation but no return to consciousness. There was bloody foam on the lips, no involuntary evacuations, no peculiar odor on clothes or breath. At the onset the pulse was 54, three hours later, 130, small and weak. Urine examination was negative except for albumin. Blood count showed polymorphonuclear leucocytosis. No bromine nor bromine compounds could be found at autopsy. The authors exposed guinea pigs to fumes of methyl bromide and found that, if the animal lived for thirty to seventy minutes after removal from the fumes, it was difficult, if not impossible, to detect methyl bromide in the body; but if it was killed immediately after exposure, the substance could be demonstrated in fluids and organs. — A. Hamilton.

The Physiological Action of Fumes of Iodin. *A. B. Luckhardt, F. C. Koch, W. F. Schroeder* and *A. H. Weiland.* Jour. Pharmacol. and Exper. Therap., March, 1920, 15, No. 1, 1–21. Abstracted as follows in Am. Jour. Med. Sc., Oct., 1920, 160, No. 4, 607. — "Iodine deposited on the skin in the form of fumes is absorbed and appears in the urine of both man and dogs. In dogs the iodin content of the thyroid was found to be greatly increased, the increase being accompanied by a corresponding change in the histological features of the gland. The same was true when the iodin was inhaled. The inhalation of iodin fumes causes respiratory disturbances consequent on the irritant action of the fumes; large amounts lead to the death of the animal within twenty-four hours from acute and rapidly developing pulmonary edema. The edema supervenes more rapidly in animals having respiratory disease than in normal dogs. The authors believe that the fumes of iodin should never be inhaled for therapeutic purposes and in persons with pulmonary disease such administration is absolutely contraindicated." — K. R. Drinker.

Some Observations on a Case of Lead Poisoning. *H. A. Lubbers.* Nederl. Tijdschr. v. Geneesk., July 31, 1920, 64, Second Half, No. 5, 409–412. — The patient, a type-founder in Amsterdam, came to the writer complaining of vague gastric symptoms; oppression after meals, headache and disturbances of vision, which had troubled him for six months. Physical examination was negative, save for a light-colored line near the gingival margin, most marked in the neighborhood of the upper canines. The gums were in bad condition. The blood showed 90 per cent. hemoglobin, no basophiles, no abnormal corpuscles, no stippling. A test meal showed anacidity. The feces were negative for blood. After being sent home with a diagnosis of anacidity of unknown cause, the patient came back in a month with much aggravated symptoms, colic and a definite lead line on his teeth. The red blood corpuscles now showed definite stippling.

A week later the patient brought in some grayish powder that he had scraped from the side of his *pot de chambre.* Upon obtaining a specimen of urine, the author had it analyzed by Mr. Keulemans, who reported the presence of metallic lead. The feces were then examined, rubbed up with water, allowed to sediment and the supernatant fluid was poured off. The sediment from this showed metallic lead, which stained the pestle a lustrous black. Inner portions of scybala were examined with the same result.

The patient was then taken into the hospital and his feces collected. Out of the first dejection, weighing 175 gm., 60 gm. yielded 80 mgm. of metallic lead; 20 gm. when incinerated yielded 33 mgm. of the metal. Out of the entire mass, then, there were 234 mgm. of metallic and 289 mgm. of total lead. At this rate, the patient must have got rid of about 0.25 gm. of lead in the three weeks after he left his work. He was quite sane, had no enemies and the lead was combined with antimony and tin, proving that it came from the shop where he worked.

Investigation showed a well-ventilated establishment, with oiled "terrasso" floor. In the room where the patient was employed there were three casting machines and other type-making apparatus. The molten lead was kept in a furnace which was fed at intervals through a trap, which was kept closed except when opened to throw in more lead.

It was found that when the machines, which were operated by keys and therefore kept the hands of the operator from actual contact with the lead, were emptied of the lines of type which had been cast, that these lines of type were removed six at a time and the slots brushed out to make room for the new type. During this operation small particles of lead would fly into the air, littering the floor about the machine. Examination of the fingers of the operators showed a metallic coating on the skin. The man operating the machine usually worked by the patient was requested to send a stool to the hospital. This he did. It was examined and showed but two small flakes of lead in 45 gm. of stool. He was examined and found to be quite healthy and his blood normal. The finger-nails of three operators in the room were cleaned and the material obtained yielded 4, 3, and 11 mgm. respectively.

Although examination of the other workmen failed to show anything commensurate with what was discovered in the case of the patient, it would be well to investigate this matter further and to consider it as a form of occupational malady. — N. C. Foot.

Lead in Urine in Neurocirculatory Disturbances. *C. A. McDonald* and *H. McCusker*. Abstracted as follows from Boston Med. and Surg. Jour., Nov. 4, 1920, 183, No. 19, 543, in Jour. Am. Med. Assn., Nov. 20, 1920, 75, No. 21, 1450. — "Twelve cases representing nervous disorders of many types are recorded by McDonald and McCusker. Not one of them showed signs of lead poisoning, like the lead line, anemia, or stippling. It was only by making a routine urinary for lead in doubtful cases that the lead element was discovered. These cases are reported to stimulate corroboration or refutation of Chapman's standard, that 0.4 mg. of lead per liter of urine is sufficient to cause symptoms; and secondly, to argue for the consideration of lead as the etiologic factor, or one of the etiologic factors, in obscure cases presenting neurologic signs and symptoms." — K. R. Drinker.

Metallic Lead in Feces. *N. Keulemans*. Abstracted as follows from Pharm. Weekblad, 1920, 57, 678–679, by J. F. Smith in Chem. Abstr., Sept. 20, 1920, 14, No. 18, 2825. — "In the case of a printer suffering from Pb poisoning, metallic Pb (in fine splinters) was found to the amount of 80 mg. in 60 g. of feces. The metal particles contained also Sn and Sb, corresponding to the composition of the type metal with which the patient worked. After a few days' absence from work, the feces contained no Pb." — W. O. Fenn.

Determination of Mercury in the Urine. *Autenrieth* and *Montigny*. Abstracted as follows from München. med. Wchnschr., Aug. 6, 1920, 67, No. 32, 928, in Jour. Am. Med. Assn., Nov. 27, 1920, 75, No. 22, 1528. — "Autenrieth and Montigny find that the quantitative determination of mercury in the urine by the colorimetric method is simple and sufficiently accurate for practical purposes. Owing to the manner in which mercury is employed, it is seldom excreted in the urine in other than very small quantities, so that the colorimetric method is especially appropriate. But this method is applicable only in case no other metal precipitated by hydrogen sulphid, such as lead, copper, silver, tin and bismuth, is present. It is just as accurate as the gravimetric method of Schumacher and Jung, and is not much inferior, if any, to the electrolytic method of Buchtala, and has the advantage of not requiring a delicate scale for its application such as is needed in the Buchtala method." — K. R. Drinker.

Rapid Colorimetric Methods for Determination of Phosphorus in Urine and Blood. *R. D. Bell* and *E. A. Doisy*. Jour. Biol. Chem., Oct., 1920, 44, No. 1, 55. Abstracted as follows in Jour. Am. Med. Assn., Nov. 13, 1920, 75, No. 20, 1373. — "Rapid

colorimetric methods are described by Bell and Doisy for the determination of inorganic and total phosphorus in urine. While not so accurate as suitable gravimetric determinations, these methods are said to be much more convenient and are sufficiently accurate for many purposes. The method for inorganic phosphate appears to be more accurate and rapid than the usual uranium titration. Methods are also described for the determination of inorganic and acid-soluble phosphorus in blood."—K. R. Drinker.

DUST HAZARDS AND THEIR EFFECTS

A Study of the Dust Hazard in the Wet and Dry Grinding Shops of an Ax Factory. *C.-E. A. Winslow* and *Leonard Greenburg.* U. S. Pub. Health Ser., Pub. Health Rep., Oct. 8, 1920, 35, No. 41, 2393–2401. — The authors conclude as follows:

"From these investigations it seems clear that the enormous incidence of tuberculosis among the grinders and polishers in this factory, indicated by Dr. Drury's study, is by no means surprising and that it is due primarily to the hazards of wet grinding.

"No dust determinations were made in the polishing shops, on account of the lack of suitable electrical connections for operating the dust-sampling apparatus. The polishing wheels were, however, equipped with an excellent exhaust system. In the case of the dry-grinding shop, which would naturally be much more dusty than a polishing shop, a similar exhaust system proved eminently satisfactory as a preventive of dust dissemination, the air showing an average of only 154,500 one-fourth standard-unit particles per cubic foot. In the wet-grinding shops, on the other hand, only 1 sample out of 32 showed less than 1,000,000 such particles, and only 12 less than 10,000,000, the general average being 15,800,000 one-fourth standard-unit particles per cubic foot. This is one of the highest values ever recorded in any industrial establishment.

"It seems evident that the protection afforded by wet grinding, as compared with dry grinding, is in this instance illusory. In order to facilitate rapid work the operators are tempted to cut down the amount of water supplied to the wheel; and in grinding a heavy object like an ax upon a wheel of soft natural sandstone the worker presses so heavily upon the wheel that the superficial film of water is pushed back behind the ax and the outer surface of moist stone is ground off, exposing a dry surface, which in its turn is abraded and discharged as atmospheric dust. The danger is increased by the fact that rapidly revolving wet wheels must be rotated upward toward the face of the worker. The principle of using moisture to eliminate industrial dust is no doubt a sound one, as exemplified in the measures taken for the protection of the miners in South Africa by the use of sprays. The present study merely emphasizes the fact that the efficacy of a process of this sort must be checked up by laboratory tests in order to determine its real effectiveness.

"It is evident that wet grinding on sandstone wheels, as practiced at the ax factory studied, is an exceedingly hazardous process, and that the substitution of dry grinding with an efficient exhaust system (or possibly the use of wet grinding on artificial abrasive wheels of a harder nature) is clearly indicated as a measure for the protection of the workers against respiratory disease." — M. C. Shorley.

Silica as a Cause of Printers' Phthisis. London Letter, Oct. 16, 1920. Jour. Am. Med. Assn., Nov. 6, 1920, 75, No. 19, 1280. — "In a letter to the *Times*, Mr. E. Halford Ross brings forward a new theory as to the causation of printers' phthisis. Early in 1918 he reported to the health committee of the joint industrial council of the printing trades that there was a concentration of hereditary predisposition to consumption in compositors owing to the 'closeness' of their craft and to intermarriage within their families. About a year ago his suspicions fell on printers' list as a cause. It is a black, grumous, woolly, fluffy substance that collects in compositors' boxes, trays, cases and chases. It had already been examined by bacteriologists for the tubercle bacillus but found to be sterile. This was a peculiar fact and encouraged Mr. Ross to make a further examination. He then found that the list does not readily decompose like the dirt collected in rulers', readers' and binders' rooms, which soon becomes musty and smells. Then he remarked its weight and realized that there was no object

in looking for the tubercle bacillus in it, for the bacillus was already latent in the human subject. A chemical analysis was carried out. Samples of list were obtained from various works and sent unlabeled to chemists. They reported that the list from composing rooms contained both silica and iron in appreciable quantities; the list from machine rooms contained less. It is known that silica and the oxids of iron light up phthisis when inhaled continually by those predisposed to the disease. The condition of the lung produced by silica, which predisposes to phthisis, has been described as silicosis. One of the great printing firms of London has for some time used suction bellows on compositors' trays, cases and chases to remove the list." — K. R. Drinker.

The Causation of Printers' Phthisis. London Letter, Oct. 23, 1920. Jour. Am. Med. Assn., Nov. 20, 1920, 75, No. 21, 1438. — "The hypothesis of Mr. E. H. Ross that the silica and iron contained in printers' list is the cause of the prevalence of phthisis among printers is challenged in a letter to the *Times* by Professor Leonard Hill the physiologist, one of the Medical Research Council appointed to inquire into industrial tuberculosis. He points out that silica and iron are found in almost any common dust, and he considers that silica dust is harmful only when inhaled for a long period and in concentrated doses, as by the workers in flint, ganister, granite and quartz. The evidence also goes to show that large amounts of silica dust can be inhaled with impunity when mixed with coal or other dust of 'edible' nature. Coal dust stimulates the cells of the air passages to clean up the lungs by phagocytic action. Pure silica particles, on the other hand, seem to have no such stimulating action and, collecting in the lung tissue, excite there a fibroid change, which finally ends in tuberculous infection. Mr. Hill points out that tuberculosis attacks the operative printers' assistants more severely than the compositors, and they do not handle the boxes of type. The air of printing shops is not particularly dusty, and it seems improbable that the inhalation of silica dust in such shops has anything to do with tuberculosis. The users of public roads, paved with granite or flint, in dry weather inhale clouds of silica dust stirred up by motorcars, but the exposure of road sweepers to the dust does not appear to produce silicosis of the lungs. What is required is daily exposure in such dusty, enclosed spaces as those in which the gritstone worker, mason, or tin and gold worker are confined. Printers' work takes place in warm atmospheres, and in sunless, artificially lighted places — conditions which lower the metabolism and vitality of the body, and predispose to phthisis." — K. R. Drinker.

Smoke Removal at Zinc Ovens. *A. Roitzheim.* Zentralbl. f. Gewerbehyg., Oct., 1920, 8, No. 10, 185–188. — One of the most difficult tasks in industrial smoke elimination is that of smoke from the condensation vessels of zinc ovens. The smoke arises from all parts of the oven and is very finely divided zinc oxide, formed by the uncondensed zinc vapors oxidizing in the air to the white oxide.

In the Rheinisch zinc smelters a wedge-like cap is used on the chimneys but this is only partially effective, while exhausts and artificial blowers work well only in connection with machines.

In one of the zinc ovens of the Oberspree-Berlin Oberschöneweide Zinc Refinery, Roitzheim devised a new method. The front of the zinc ovens were completely cut off from the outside by double-wing cast iron doors. For observation and working, holes 50 mm. wide are drilled. When closed the wings of the doors form a closed chamber, which, except for cracks, joints, and the observation holes, shuts off the ovens completely. The molten zinc in the ovens can be drawn off without opening the chamber, which in turn is connected with a 50-m. chimney. The draught loss is negligible and cold air is prevented from undercooling the zinc.

The zinc oxide mixture is led off through a system of canals with sharp turns so that in these corners the majority of the escaping zinc smoke collects.

That the method is successful is borne out by its long satisfactory use in a large factory in a thickly settled Berlin suburb. — H. V. Williams.

The Menace of some Factory Dusts. *David J. Price.* Abstracted from Tea and Coffee Trade Jour., 1920, 39, pp. 166–170, by Charles E. Munroe in Chem. Abstr., Oct. 10, 1920, 14, No. 19, 2988. — "A description, with photographs, is given of recent explosions from spice, sugar, cocoa, and cork dusts. — W. O. Fenn.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Immunity to Tuberculosis among Workers in Sulphur Dioxide. *F. Tweddell.* Med. Rec., Aug. 21, 1920, 98, No. 8, 310–312. — "Having used sulphur dioxide with good results in the treatment of pulmonary and laryngeal tuberculosis for the past four years, I thought it might be of interest to know if men who were exposed to this gas in industries where it is used were benefited or harmed thereby." A circular was answered by thirty-eight companies, thirty-one of which testified that they had never had a case of tuberculosis among their men. The twenty-nine companies who gave adequate returns employed a total of 11,085 men, of whom 7,707 were habitually exposed to sulphur dioxide or sulphuric acid. Fourteen companies reported being in existence for periods the average of which was over twelve years. Only twenty-two cases of tuberculosis were noted during the entire period of the existence of all these firms. When from these cases there are eliminated cases which could not have been produced during the term of service, etc., very few are left. The replies to the circular seemed to corroborate the opinion that men working exposed to the chemicals under consideration were unusually free from pulmonary and throat diseases, including influenza and common colds. — G. E. Partridge.

Tea Taster's Cough. U. S. Nav. Med. Bull., Oct., 1920, 14, No. 4, 669–670. — "Dr. A. Castellani in a recent address on the relation of the higher fungi to human pathology, delivered before the Royal College of Physicians, London, gave an interesting account of a case of chronic bronchitis in an assistant in one of the big Ceylon tea firms. A number of medical men had diagnosed tuberculosis, but the patient informed the author that he merely had 'tea taster's cough.' Dr. Castellani admits that he never heard of such a malady before. Physical examination revealed nothing but a few coarse râles in the chest, and the sputum was negative for bacillus tuberculosis. It contained, however, some mycelial filaments and yeastlike bodies.

"Tea tasters not only taste infusions, but often fill their hands with tea leaves and bury their noses in them and snuff them up. A certain amount of dust is thus inhaled. The tea dust of Ceylon constantly contains fungi of the genus *Monilia*, frequently contains those of *Aspergillus* and *Penicillium*, and sometimes fungi of *Oïdium* genera. A peculiar streptococcus also occurs. These organisms are not rarely found in the nasal cavities of tea tasters and in the bronchial secretions when they have a cough.

"Somewhat similar affirmation may be made about workers in tea factories. When these workers develop a cough, lose weight and strength from inhalation of dust, they must leave the factory and go to the country, when the symptoms gradually disappear." — C. C. Lund.

The Saprophytic Growth of Anthrax on Animal Hair. *Victor Gegenbauer.* Arch. f. Hyg., 1920, 89, No. 5, 202–222. — Anthrax will grow on hair at 20° C. in the presence of hygroscopic moisture. Inoculations on hairy animals show a spread of the growth over areas 10 to 100 times greater than the area inoculated.

Anthrax has often been recovered from skins which appear to be perfectly normal and the author believes that the infected skin or hair of normal healthy animals may play a considerable rôle in the spread of anthrax. Animal hair may become infected by contamination from the discharges of sick animals or from dust or water or fodder which has been so infected. — H. F. Smyth.

Method for Securing more Resistant Anthrax Spores. *Rupert Reiter.* Arch. f. Hyg., 1920, 89, No. 5, 191–201. — Different strains of anthrax vary in their resistance to heat; strains of high resistance should, therefore, be used as test material.

Heider's wheat-extract-agar is the best culture medium for developing anthrax spores of maximum heat resistance, as it always develops more resistant spores than does any other medium suggested.

Subcultures to test the action of disinfectants, etc., on anthrax spores should be made in dextrose-serum-bouillon (3 per cent. dextrose, 5 per cent. serum) as spores will vegetate in this medium when they refuse to do so in ordinary bouillon. — H. F. Smyth.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Cutaneous Lesions from the Use of Artificial Fertilizers. *Giuseppe Pavia.* Il Lavoro, Sept. 30, 1920, 12, No. 5, 131–134. — The use of calcium cyanamide has recently been introduced in Italy as a nitrogenous fertilizer. It is extremely dusty and light, and easily works through the clothing. When the peasant scatters it by hand it forms a cloud in the air and falls on his sweating skin. Very severe lesions are produced on the mucous membranes of the nose and throat and on the skin, especially of the forearms. Another irritating fertilizer is calcium nitrate. The author describes a patient who suffered severely with burning pains on the forearms and knees. Vesicles formed, and then ulcers, which were very slow to heal, and when seen at the end of twenty days, it was necessary to send him to a hospital for treatment. According to popular belief, blonds are very much more sensitive to both compounds than are brunettes. Lesions of calcium cyanamide usually take from twenty-five to forty days to heal. — A. Hamilton.

The Professional Stigmata of Ice-Cream Makers. *Luigi Ferrannini.* Il Lavoro, Aug. 31, 1920, 12, No. 4, 97–101. — This is an illustrated article dealing with the callosities which form on the hands of ice-cream makers in Italy where apparently the turning of the ice cream is all done by hand. The work is said to be carried on continuously from three to fifteen hours out of the twenty-four, and the apprenticeship for this work begins at the early age of ten years. — A. Hamilton.

Perforating Wounds of the Eye: An Investigation of 106 Cases Occurring in Soldiers at a Military Center in London. *G. Maxted.* Abstracted as follows from Brit. Jour. Ophth., 1920, 4, p. 12, by T. D. Allen in Internat. Abstr. Surg., May, 1920, 30, No. 5, 406. — "This paper reports the results of 106 eye wounds not necessitating immediate enucleation. The nature of the accident, the seat of perforation, the injury to the lens, the prolapse of the iris, sympathetic ophthalmia, and vision are all considered.

"There was only one case of sympathetic ophthalmia in the series although there were 37 wounds in the danger zone and 46 cases of foreign bodies in the eye. In 24 of the 46 cases the body had been extracted early with a magnet before the patient was seen by the author. The eye was enucleated in 9 of the remaining 22 cases. One patient died following another operation; 9 left the hospital with the foreign body still in the eye but had light perception. The remaining 3 had vision of 3/60, 6/36, and 6/9 at the time of the report." — K. R. Drinker.

Eye Injuries. *Frank C. Trebilcock.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 261–266. — Careful examination is often necessary to detect attempted fraud on the part of persons with mild eye injuries. Two cases are described. Traumatic cataracts are now more or less readily removable surgically, but removal is not always desirous except from the cosmetic point of view. Unintelligent persons with traumatic cataract are best left alone, but intelligent patients should be given the right of choice as to surgical removal. — Barnett Cohen.

The Effect of Concentrated Alkalies and Acids on the Eye. *A. Sigrist.* Abstracted as follows from Ztschr. f. Aughlk., 1920, 43, p. 176, in Therap. Halbmonatsh., Sept. 1, 1920, 34, No. 17, 489. — "The observation of a severe accident to the eye with cloudiness of the cornea and iridocyclitis caused by hot caustic soda solution induced the author to reopen the question as to the action of concentrated alkalies and acids on the eyes of rabbits. Experiment and clinical observations show that alkalies when they reach, even in small doses, the conjunctival sac are capable of diffusion through the cornea and may lead to severe injury of iris and ciliary body. The only way of preventing such an effect is to wash out the eye thoroughly within five minutes of the entrance of the alkali. Therefore in practice a harmful result can hardly be prevented. Ammonia can be demonstrated in the anterior chamber within five seconds after introduction, and puncturing the anterior chamber lessens the danger of damage to the interior of the eye. The effect of acids is more superficial, a thick crust forming at once and preventing the further penetration of the acid." — A. Hamilton.

Secondary Inflammation of the Eye after Hydrogen Sulphide Poisoning. *Hoppe.* Abstracted as follows from Ztschr. f. Aughlk., 1919, 43, p. 195, in Therap. Halbmonatsh., Sept. 1, 1920, 34, No. 17, 490. — "Employees in a sulphur factory in which hydrogen sulphide is formed as an intermediate product are attacked from time to time by an extremely painful inflammation of the eyes with swelling of the lids, photophobia, and hyperemia of the conjunctiva. It is characteristic that these symptoms come on as a usual thing some hours after the workmen have left the atmosphere of hydrogen sulphide fumes and that there is no other disturbance of health. The warning signs consist in the appearance of a colored ring around the light and an increased sensitiveness to all kinds of illumination. The extreme photophobia is probably caused by an affection of the corneal epithelium. Since hydrogen sulphide does not possess any real caustic action, Hoppe is inclined to believe that the irritation is an indirect effect following a previous inhalation of some poison so far not isolated. Even if this part of the subject is not yet clearly understood, Hoppe advises that the workmen should be protected against the poisonous fumes by appropriate gas masks." — A. Hamilton.

Amblyopia from Carbon Disulphide. *Terrien.* Abstracted from Paris Médical in Il Lavoro, Sept. 30, 1920, 12, No. 5, 147. — Terrien reports two cases of central scotoma with notable reduction of the visual field in two persons who had been exposed to the vapors of carbon disulphide, throughout an eight-hour day, while spreading a solution of rubber in benzine and carbon sulphide on paper in order to make mustard plasters. A retrobulbar neuritis was found similar to that caused by nicotine and by alcohol. — A. Hamilton.

Recognizing Eyesight as an Industrial Asset. Nat. Assn. Corporation Training Bull., Nov., 1920, 7, No. 11, 496. — From the point of view of efficiency and safety, few factors in industry are of greater importance than the integrity of the eyesight of the workers. Yet systematic examination of the eyes of employees is a very recent welfare measure. Great advances have been made in the direction of proper lighting of buildings, etc., but this is only a part of the requirements. These provisions have reference mainly to general conditions and normal eyesight, whereas the percentage of defective eyes among workers is very high, and consequently in many cases the general provisions must be supplemented by attention to the individual. At the present time there is a wide range of service rendered to workers, including preliminary examinations in connection with medical tests, advice as to treatment, attention to emergencies, free hospital service, and the services of expert oculists. — G. E. Partridge.

Ears and the Job. *Estelle E. Samuelson.* Laryngoscope, Aug., 1920, 30, No. 8, 501–504. — This paper discusses the work of the New York League for the Hard of Hearing in securing employment for deaf persons. According to the author, a deaf person is an asset in a business office because he concentrates better than others; he is more efficient at general routine because he is accustomed to monotony and isolation; he does more work in less time than a hearing person because he does not engage in the chatter going on about him; he recognizes his limitations and does not seek constant change; he is a master of detail. — K. R. Drinker.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

Reorganization for Prevention of Accidents in Industry. *Hans Hederich.* Zentralbl. f. Gewerbehyg., Sept., 1920, 8, No. 9, 179–182. — Article 161 of the new constitution declares that maintenance of health and of the ability to work is the chief aim of social insurance. Under the new régime the executive organs for the prevention of accidents are the various technical inspectors of the individual industrial companies. These, whose business it is to set rules for accident prevention, ought to be academically trained, and should have many years of practical experience.

As a guide for the simplification of the process and for a consolidation of the costly work, the author proposes some thirteen rules. He suggests the appointment of common technical inspectors for all trades with the same or similar machines and processes. Those industries with little element of danger should be grouped with similar industries where the danger factor is great. The inspector should have

powers not subordinate to, but rather coordinate with those of the business agent, and full independence of action should be granted him. Penalties upon workers and contractors for infractions of the regulations, as well as prohibition to work on machines which are unprotected, or where the safety device is impaired, are prescribed. Other suggestions are a central bureau for exhibition of safety devices, the placing, so far as is possible, of the dangerous parts in the interior or less readily accessible portions of the machine, appointment of workers as aids to the technical inspectors, extension of social insurance to clearly demonstrable industrial diseases, and the immediate investigation of large scale accidents by official inspectors. — H. V. Williams.

Safety. *H. J. Wilson.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1919, pp. 12–32. — As a preliminary to accident prevention it has been found essential to have a careful analysis made of all accidents occurring in a particular industry and so classified as to bring into prominence not only the machines which cause the majority of casualties but the respective parts of these machines.

Attention is drawn to the number of accidents which result from some defect in plant or error in design of machines. There are, however, a large number of accidents preventable through the training and education of the worker. Experience has shown that a reduction of accidents can be secured by the interest and co-operation of operatives and officials through the agency of the safety committees.

Works committees dealing with a wide variety of subjects affecting the general welfare of the workers have succeeded in exerting an excellent influence in abolishing friction between management and operatives.

This article deals extensively with the accidents to specific types of machinery, such as transmission machinery, cranes, hoists, power presses, baker's machinery, grindstones, laundries, steam boilers, etc. Fires and explosions are also discussed. — L. A. Shaw.

Dangerous Trades. *G. Stevenson Taylor.* Great Britain, Ann. Rep. Chief Inspect. Factories and Workshops for 1919, pp. 33–43. — The observance of the Special Rules and Regulations for dangerous trades is still below the pre-war standard. This seems to be due to the fact that repairs have not yet caught up with the general wear and tear on the plants which were occasioned by war-time production. Few deliberate evasions have been noted.

The reports from the inspectors respecting the status of each occupation which is governed by safety rules are herewith presented. The following occupations are thus included in the reports: file cutting by hand; electric accumulators; docks; self-acting mules; wool sorting and combing and East Indian wool; locomotives; horsehair; casting of brass; vitreous enamelling; nitro and amido derivatives of benzene; tinning of metal holloware; grinding of metals and racing of grindstones; lead smelting; bronzing; pottery; shipbuilding; refractory materials; hides and skins; vulcanising of India rubber by means of bisulphide of carbon; chemical works; aerated water bottling; and tar distilling. — L. A. Shaw.

Explosions from Pressure Valves of Oxygen Tanks. *H. J. Scholte.* Zentralbl f. Gewerbehyg., Oct., 1920, 8, No. 10, 196. — To the eight rules of Gärttner-Stuttgart for prevention of explosions from the pressure reducing valves of oxygen tanks, the author would add a single observation which he deems most important. The author believes that in many cases the heat of compression causes a burning of the hard rubber packing. The flame then spreads and burns vigorously in the highly compressed oxygen, heating the iron and steel and melting the brass. A table of heats of compression is appended.

The author's principle of explosion prevention is to give the hot compressed air opportunity for escape. This is to be accomplished by leaving the cock of the outlet valve wholly open, opening the reducing valve a little and turning in a bit the lever screw on the valve. Although some oxygen is lost, the author believes that the added factor of safety more than compensates.

An apparatus constructed with downward directed exhaust is also suggested. — H. V. Williams.

Two New Protective Devices from the Amsterdam Safety Museum. *H. J. Scholte.* Zentralbl. f. Gewerbehyg., Oct., 1920, 8, No. 10, 195. — From the Amsterdam Museum of Safety, the first institution to exhibit safety appliances on machines instead of on models, there come two new devices. One is for shafts

with internal threads on lathes and polishing machines, where the conical worm bolt is screwed onto instead of into the axle end. In this way the outside thread of the axle is used.

Filarski has found a solution for the supplemental operation of bolts with internal threads. A pin is driven centrally into the axle end with the inside thread, so that the hole is filled in such a manner that not even the smallest finger can enter. A hole one or two millimeters larger is bored into the thread bolt and the device is complete. — H. V. Williams.

INDUSTRIAL SURGERY

Industrial Injuries and First Aid. A Plea for the Immediate Treatment of the Injured. *A. C. Burnham.* Med. Rec., Aug. 21, 1920, 98, No. 8, 307–310. — Recent estimates and statistics show two important facts: a shortage of about 6,000,000 workers in the United States, and a high accident rate. In 1918 there was a total of 184,844 accidents, of which 3403 were fatal. Tables showing the nature of the injuries and their distribution in occupations reveal the fact that approximately a third of the accidents are attributed to the metal and metal-products trades; and that crushes and bruises, cuts and lacerations make up more than 120,000 of the total of about 180,000 accidents.

The function of the medical profession in this situation is plain. Indirectly it becomes a producer by conserving the human factor, and its especial function is necessarily the care of the injury after it has occurred. It is at this point that various practical problems appear, some of the most important of them arising from the generally recognized fact that the earlier an injury receives intelligent attention, the better are the chances of recovery and the shorter is the period of disability. From this viewpoint arises the question of the value of voluntary aid and of the advisability of training first-aid assistants in factories, mines, schools and the like. There are at present conflicting views among physicians on these points, but at least some first-aid measures applied by a non-medical attendant appear to be allowable. Among these comes, first, the application of iodine to wounds, now well understood and amply justified by experience as one of the best methods of early treatment. In the case of burns the treatment is less clearly indicated, so far as first aid is concerned. Some use carron oil, but probably equally good results are obtained from boric acid ointment or even sterile petrolatum, although some prefer picric acid either in weak solutions or in the form of picric acid gauze. When the surgeon can be reached in a few minutes it is perhaps better not to have any dressing at all applied by the volunteer first-aid assistant. The use of the tourniquet by first-aid workers must be carefully supervised, for too often it is applied so that only the venous blood is blocked, thus increasing the bleeding rather than diminishing it. First aid in fractures should be limited largely to measures for the prevention of further injury, such as simple splinting. — G. E. Partridge.

Infections of the Upper Extremities. *P. A. Bendixen.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 229–237. — The infected upper extremity does not get the painstaking intelligent treatment that its economic value demands. The cause is usually an external trauma breaking the continuity of the skin and permitting the entrance and multiplication of pathogenic organisms. It is claimed that the indiscriminate use of hydrogen peroxide by laymen is bad. The author classifies the various infections according to their anatomical location. Diagnosis and prognosis are discussed and it is emphasized that intelligent treatment can eliminate a good deal of the grave sequelae usually occurring. No matter how slight the accident it should be reported and proper treatment given. — Barnett Cohen.

Fracture of the Tip of the Distal Phalanx. Report of Twenty-Seven Cases. *Russell F. Maddren.* Jour. Am. Med. Assn., Oct. 30, 1920, 75, No. 18, 1198–1200. — The author reports upon twenty-seven cases and has had uniformly excellent results when surgical intervention was prompt. "All the cases occurred in adult male factory workers, and an average of only 6.3 days apiece was lost from work." Immediately upon diagnosis an incision into the closed connective tissue sac containing the pulp of the finger tip should be made. "If the pressure is relieved promptly

and without procrastination, its sequelae — pain and delayed sepsis — will not supervene." Local anesthesia can be employed and the site and the extent of the incision or incisions varied in accordance with the needs of individual cases.

The author's conclusions are as follows:

"1. Fracture of the tip of the distal phalanx is not a trivial injury.

"2. Early recourse to surgery, rather than expectant treatment, is indicated.

"3. The results of prompt surgical treatment in a series of twenty-seven consecutive and unselected cases have been uniformly excellent." — C. K. Drinker.

Foot Abnormalities and their Management in the Light of Army Experience. *T. S. Mebane.* Mil. Surgeon, Oct., 1920, 47, No. 4, 428–435. — The author concludes with the following summary:

"1. A foot may be considered normal when there is unrestricted joint motion and the line of weight bearing passes through the fore foot.

"2. Foot trouble can be prevented by wearing proper shoes, by correcting faulty attitudes, by care to prevent overtaxing, by eliminating focal infections and by the use of exercises to strengthen the foot muscles.

"3. Symptoms referred to the feet are encountered in many conditions.

"4. The cure of static foot defects is dependent upon muscle training. Mechanical correction by plates or shoe alterations is to be regarded only as an aid to treatment." — K. R. Drinker.

Acid Burns on Hands of Solderers. *Harry W. Keatley.* U. S. Pub. Health Ser., Pub. Health Rep., Sept. 10, 1920, 35, No. 37, 2161–2163. — This is a brief discussion of the experience of the Curtis Bay General Ordnance Depot in reducing acid burns. It was found that the men soldering air-tight containers for shells received a considerable number of acid burns from the soldering flux which they used. It was at first suggested that they wash their hands frequently in a solution of bicarbonate of soda. Later experiment however showed that by reducing the flux to one-half strength the work could be done just as satisfactorily with a 50 per cent. saving in cost of acid and the elimination of the acid burns. — C. H. Paull.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

The Chlorides of the Blood and of the Muscles in Fatigue. *Amati.* Il Lavoro, Sept. 30, 1920, 12, No. 5, 159. — Amati read a paper before the Royal Academy of the Medical Sciences in Palermo, February, 1920, in which he showed that the quantity of chlorides in the blood is constantly augmented by fatigue, and that the same thing is true of the chlorides in the muscles. The increase in the muscles is attributable to the greater volume of blood present in the muscles, for it is not found in muscles that have been bled white. — A. Hamilton.

Some Phases of Protein Catabolism and Fatigue. *E. L. Scott* and *A. B. Hastings.* U. S. Pub. Health Ser., Pub. Health Rep., Oct. 15, 1920, 35, No. 42, 2445–2462. — This article is summarized as follows:

"1. The concentration of total and neutral sulphur, total, ethereal, and inorganic sulphates, total and combined phenols, and total nitrogen in the morning and afternoon urines of a number of resting individuals and individuals subjected to work of varying degrees of arduousness has been determined.

"2. A tendency for a greater excretion of total sulphur per gram of nitrogen at night than in the morning has been noted in both groups of men. The greater part of this increase has been attributed to the sulphur of the food ingested. There seems, however, to be a somewhat greater output in men subjected to the more severe operations.

"3. There is practically no increase in the output of sulphate sulphur per gram of nitrogen during the day in men in bed, whereas there is an undoubted increase in men subjected to labor. This increase is larger the more severe the labor.

"4. There is a tendency for the proportion of total sulphur (which is eliminated as sulphate) to increase during a day of exercise; and this tendency is much more marked the more severe the exercise.

"5. The severity or arduousness of any particular form of labor may be judged by the ratio of the morning to the afternoon sulphate of the urine, providing a sufficient number of determinations have been made upon several individuals.

"6. Our experimental results apparently indicate that the ability of the human organism to conjugate the phenol bodies is unchanged by moderate muscular effort.

"7. Directing our attention to the absolute excretion of unconjugated phenols, we find that this quantity is increased slightly by moderate work and greatly by strenuous exercise. This suggests that the free phenol excretion may be a factor in severe fatigue.

"8. Theoretical considerations indicate that the average worker excretes more indol and allied substances, particularly as sulphates, than men with whom care is taken to maintain regularity of habits and a wise selection of food.

"9. Because of the greater dependence of the phenol production and excretion upon the peculiarities of habit and diet of men than upon their muscular activity, no progressive change in quantities or proportion of phenol excretion could be correlated with increasing arduousness of occupation, except in the instance of strenuous exercise.

"10. It is thought that simultaneous analytical studies must be made of the phenol and indol groups and the substances with which they are conjugated, notably sulphuric and glucuronic acids, before a positive statement of their relation to fatigue is justified." — M. C. Shorley.

Should the Eight-Hour Day be Continuous or Interrupted? *Pieraccini.* Abstracted from Nuovo Giornale in Il Lavoro, Aug. 31, 1920, 12, No. 4, 107–111. — To the question whether, from the hygienic point of view, the newly introduced eight-hour day should be interrupted by a short or a long lunch period, Pieraccini speaks strongly in favor of a long interval between morning and afternoon work. He believes that a lunch period of only half an hour, during which the workman has time for only a cold lunch, will result in serious disturbances of digestion, of nutrition, and of the nervous system. An hour and a half at noon is necessary if the factory is far from the workman's home, unless there is a restaurant in the factory itself. In any case, however, rest is necessary, and he therefore believes that an interval of two hours should be allowed. He suggests a summer schedule of four and a half or five hours' work in the morning, two hours' rest, and three hours and a half or three hours in the afternoon, while in winter the hours could be equally divided. — A. Hamilton.

INDUSTRIAL SANITATION: FACTORY CONSTRUCTION, ILLUMINATION, VENTILATION, HEATING, WATER SUPPLY, SEWAGE DISPOSAL

Modern Industrial Lighting for Oregon. *F. H. Murphy.* Electrical World, Oct. 23, 1920, 76, No. 17, 820–823. — A discussion of the new industrial lighting code of Oregon and its relation to the recommendations of the Illuminating Engineering Society and other state lighting codes. The minimum lighting requirements for various classes and parts of shops are practically the same as those adopted by Wisconsin. Special emphasis has been placed upon the elimination of glare. — G. M. Fair.

Illumination of Machine Tools. *G. Wagschal.* Electrical World, Nov. 6, 1920, 76, No. 19, 925–926. — A description of the lighting equipment and illumination intensities in the Central Gear Company of Detroit. The average intensity is 15.35 foot-candles over machines and 10.85 foot-candles over aisles, corresponding to an energy consumption of 1.6 watts per square foot, exceeding therefore by 60 per cent. the old empirical rule of 1 watt per square foot. — G. M. Fair.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

Volume II | MARCH, 1921 | Number 11

CONTENTS

INDUSTRIAL MEDICAL SERVICE: MEDICAL DISPENSARIES AND HOSPITALS IN INDUSTRIAL PLANTS

Industrial Medicine: Its Proper Relation to Industry. *S. Dana Hubbard.* New York Med. Jour., Aug. 14, 1920, 112, No. 7, 212–214. — The writer reviews in very general terms the field of industrial medicine, indicating what he believes to be its functions and correct ideals. Employers are beginning to realize that the subject of health vitally concerns their industrial problems; medical and surgical supervision of work is essential in order to produce efficiently, since capacity depends probably more largely on the physical and mental condition of the workmen than on any one single factor. The first step in the conservation of energy and health is to learn the facts of the physical condition of the workmen; and since the value of medical service will be measured by its effect on production, the most useful industrial medical departments are those best able to prevent accidents and absence incident to illness. To obtain the best results, the medical supervision must extend to the care of the sick workmen at home, and to interest in domestic and community problems. In regard to detail, the duties of the medical profession in industry may be said to be very numerous, including both educational and preventive measures as well as actual medical and surgical treatment. — G. E. Partridge.

Industrial Medicine as Related to Efficiency. *John A. Turner.* Mod. Med., Oct., 1920, 2, No. 10, 668–671. — This is an article presenting a concise outline of the more generally approved practices concerning equipment, personnel and service relations of present-day industrial medicine. Housing and equipment of the health department is discussed. Important considerations in selection of personnel are suggested; and the functioning of a model health department is presented in some detail.

Emphasis is put upon the opportunity for investigation. Possible lines of special study with the view to increasing efficiency are enumerated under the following heads:

Factors contributing to accidents
Causes of occupational disease
Non-industrial health conditions
Absenteeism and labor turnover
Stocktaking of physical assets
Physical and temperamental requirements of various processes
Co-operation with other departments.

The importance of non-industrial as well as industrial sickness is illustrated by several sets of figures compiled by the U. S. Public Health Service, the New York City Health Department, and by the Metropolitan Life Insurance

Company, all suggesting the economic losses due to illness.

Factory inspection is naturally referred to as the means by which the physician must obtain his information upon lighting, ventilation, personal service and other environmental conditions. Education in personal hygiene is mentioned last as constituting a large part of the plant physician's duty to his workers. — H. W. Stevens.

Varying Systems in Plant Hospitals. *Sanford DeHart.* Hosp. Management, Aug., 1920, 10, No. 2, 50–52. — The author considers that medical and surgical requirements, together with the element of hazard, differ so widely in different factories that standardization of medical service is impractical. — L. A. Shaw.

Medical Service for Cement Workers. *Charles E. Coleman.* Hosp. Management, July, 1920, 10, No. 1, 62. — The two plants which Dr. Coleman represents, Marquette Cement Manufacturing Company and Lehigh Portland Cement Company, Oglesby, Illinois, have a centrally located first-aid room with all necessary equipment for treating injuries and making physical examination of employees, and first-aid cabinets in the various departments. The more serious cases are taken to the hospital, as neither company has a plant hospital.

Dr. Coleman outlines his methods of physical examination, of preventing infection of wounds, of treating cases of shock, cases of cement in the eye, and burns. — L. A. Shaw.

Medical Service of General Electric Company. Hosp. Management, Aug., 1920, 10, No. 2, 54, 56. — This article describes the methods employed by the General Electric Company in the administration of medical service throughout its plants in Schenectady. — L. A. Shaw.

Two Hundred Cases Treated Daily. Hosp. Management, July, 1920, 10, No. 1, 58. — This short article deals with the work of the Burroughs Adding Machine Company hospital at Detroit. Although the majority of cases treated are finger injuries, the hospital is equipped to handle nearly every variety of ailment. All of the dressings used in the Burroughs hospital are sterilized by means of a Rochester steam sterilizer and the equipment is kept up-to-date in every respect. The surgical instrument case contains all of the instruments that might be required in any emergency. — L. A. Shaw.

How Can Medical Service Be Improved? *Morton R. Gibbons.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 288–293. — Any plan should take into consideration the psychology of the injured workman and free his mind of apprehension. It should provide the proper environment and it should provide the proper surgical care; it should include the lately well-learned lessons of occupational therapy, physiotherapy and re-education; it should include a certain discipline to which the injured individuals should be subjected in order that they may not avoid the necessary treatment and environment. — Barnett Cohen.

How Can Medical Service Be Improved? *Otto P. Geier.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 284–287. — The worker is entitled to more prompt attention, to better surgical and hospital care and to more scientific rehabilitation than he is today receiving on the average. Industrial accident commissions should take a wider view of their public trust; should seize upon the fundamental program of the prevention of occupational disease and accident as a part of their obligation to the state; and should appreciate the absolute necessity of thoroughly supervising all of the surgical and hospital attention received by the injured worker. Otherwise, enormous unnecessary economic loss and suffering will continue to prevail. — Barnett Cohen.

The Securing of Proper Medical Service for Injured Persons. *John W. Trask.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273. Aug., 1920, 278–283. — The question for the U. S. Employees' Compensation Commission resolves itself into ascertaining who the competent, well-trained surgeons with necessary temperamental qualifications are, and where located, and placing the injury cases in so far as possible under their supervision and care. The matter of hospitals is of little concern as compared with the sur-

geons. Where the service of a specialist is indicated, such service should be furnished. The experience of the federal commission has been that the whole question of adequate medical service to its beneficiaries depends upon getting the injured employee under the care of a well-trained, competent surgeon who will conscientiously do whatever is possible in the physical restoration of the patient. The injured secures the maximum of benefit at minimum cost to the government. — Barnett Cohen.

INDUSTRIAL PERSONAL AND COMMUNITY HYGIENE: HOUSING, ETC.

Company Housing in the Bituminous Coal Fields. *L. Magnusson.* U. S. Bur. Labor Statis., Month. Labor Rev., April, 1920, 10, No. 4, 215–222. — A survey of mining towns made by the Bureau of Labor Statistics in 1916, with special reference to housing by employers, showed that the responsibility for the housing of a large proportion of miners in the United States has been undertaken by the mine operators; that the average company mining town has few of the amenities of ordinary community life; that the average miner's house has about four rooms; and that the rents are comparatively low.

Observations made especially of the bituminous coal region led to the conclusion that the chief characteristic of every company mining town is its uniformity; that streets are usually wide and lots ample; that sidewalks are infrequent; that the desire to locate houses near the mines has often led to the sacrifice of conditions of health and comfort; and that sometimes advantage has not been taken of prevailing winds in placing houses so as to avoid smoke from ovens. The type of house used in the bituminous coal region of western Pennsylvania has changed very little from what it was in the early days of coal mining. Two plans prevail — the single or detached house and the double or semi-detached house — although a few row houses are found in the Pennsylvania and West Virginia and the Colorado and Wyoming districts. The prevailing plan of house in the Birmingham district is a hip-roofed cottage about 28 feet square, with a chimney in the center of the roof, a front porch running the full length of the house, and a small porch in the rear. A type of house peculiar to all southern towns is the so-called "shot-gun" house, shaped like an oblong box, and divided into three rooms in a row, with the doors frequently connecting the rooms in alignment. The prevailing size of dwelling for a family in the Pennsylvania and West Virginia bituminous coal region is either three or four rooms. A considerable proportion of two-room houses is found in the bituminous coal regions of Alabama, Tennessee, and Kentucky. (A table shows the percentage of company dwellings having specified number of rooms per dwelling, by industry and district.)

Sanitary conveniences are rarely found in mining towns. Less than 2 per cent. of the houses in the bituminous districts have inside toilets. In the anthracite coal mining regions the percentage is 19.2; in the iron mining districts 12.0; and in the copper mining districts, 45.0. There is an absence of careful maintenance in company mining towns except in a few striking instances. There is no garbage collection or provision made for garbage disposal in thirteen of fifty-three communities. Generally speaking, where the company observes system in keeping streets and alleys clean and in repairing houses, and has a regular man or corps of men to do that work, yards also are in a better condition. It is the experience of the general superintendent of one of the largest coal and coke companies in western Pennsylvania that once the company provides an adequate house and sightly premises, the employees, and especially the wives of employees, take a new interest in the house.

The percentage of company houses renting at specified amounts per month, by industry and district, is shown in a table, and the article is illustrated by eight photographs. — G. E. Partridge.

Provisions for Housing Women Employees. Nat. Assn. Corporation Training Bull., Nov., 1920, 7, No. 11, 489–491. — A survey of about three hundred industrial and commercial organizations shows that eleven of them have established dormitories or other special housing facilities for their women employees. Some companies assist in the housing of their employees by subsidizing the local

Young Women's Christian Associations, and others offer a certain amount of help by maintaining directories. The dormitories reported range in size from accommodations for twenty-eight girls to accommodations for 120. As a rule two or more girls share a room, although most of the dormitories have a few single rooms. Generally no salary limitations or other such limitations are prescribed for the privilege of living in the dormitories. In no case reported are the houses self-supporting, and in the majority of cases the housing is regarded as a temporary measure, made necessary by present conditions. — G. E. Partridge.

INDUSTRIAL INVESTIGATIONS AND SURVEYS

A Study of Output in Silk Weaving during the Winter Months. Industrial Fatigue Research Board Report No. 9. Textile Series No. 3. His Majesty's Stationery Office, London, 1920, pp. 69. — The conclusions arrived at in this investigation are as follows:

"1. Because of the great variety in the kinds of cloth manufactured and the variability of the quality of the materials, the measurement of distribution of output is peculiarly difficult in silk mills, and deductions from the measurements can only be made from any general tendencies they display.

"2. Various influences at work at different parts of the day are sufficiently powerful to determine a definite shape for the curve of distribution of output during the day. The main departures of this curve from the ideal curve — the straight line — occur at the beginning and end of the day. On the whole the investigation tends to support the conclusion that unbroken $4\frac{1}{2}$-hour and $4\frac{1}{4}$-hour spells of employment are too long, but it does not appear to be possible to settle the point at issue merely by measurement of output rates; the need for a test of a physiological or psychological nature to determine the degree of fatigue existing in the individual at any instant is emphasised.

"3. Any fatigue developed during the day by the average worker is not carried over to the next day in sufficient degree to affect the rate of output on that day. This is a generalization only — it may not be true for exceptional days.

"4. The 'Monday effect' is present among silk weavers. Its real effects were increased in the investigations described by the lower weaving qualities of the materials on Monday morning, owing to their standing during the week-end in reduced temperatures.

"5. A gradual increase in the output of silk weavers occurs from December to March, the period covered by the investigation. This increase is occasioned principally by the reduction of the length of time of the day in which artificial lighting is necessary, and to a smaller degree by the disappearance of the depressing influences of the winter months.

"6. Under artificial illumination production falls, even if electric light of sufficient intensity is provided. The magnitude of this fall is of the order of 10 per cent. of the daylight value of the rate of output. Every unnecessary hour under artificial light means a direct loss of production and makes the task of the worker more difficult than it need be.

"7. Much time is lost by workers and managements in many silk mills. The development of greater co-operation between managements and workers in these mills will have to take place before much improvement can be effected. In every mill a simple analysis of time-keeping should be prepared for the benefit of the whole industry.

"8. Efficiency and output records should be kept wherever possible.

"9. Output could in many cases be increased greatly if: (a) detailed plans for the weavers' work were made sufficiently far ahead; (b) it were made possible for weavers to spend all the time they are at the works in making cloth; (c) modern methods of management were applied sympathetically to promote better relations with the workers, and to provide them with an incentive to keep good time.

"10. 'Making-up' day disturbs the normal rates of output. It is a mistake to 'make-up' in the middle of a day, particularly if that day is near the end of the week.

"11. Within a temperature range of 58° F. to 65° F. output tends to increase with temperature. The temperature of a silk-weaving shed or room should not be allowed, during the night or week-end, to fall many degrees below the working temperature of the rooms. (The existing practice in one of the most efficient mills visited is to prevent any fall of temperature below 60° F. at night or during the week-end.)

"12. No relation between output and humidity has been disclosed." — M. C. Shorley.

INDUSTRIAL SERVICE AND MUTUAL BENEFIT ASSOCIATIONS

Model Benefit Association. Hosp. Management, Aug., 1920, 10, No. 2, 58. — The Westcott Mutual Aid Union of the International Harvester Company, Richmond, Ind., is an example of a well-organized and efficient employees' mutual benefit association that is adapted for a plant employing from fifty to one thousand men. The operation of this association is herein outlined. — L. A. Shaw.

INDUSTRIAL HEALTH LEGISLATION: COURT DECISIONS: WORKMEN'S COMPENSATION AND INSURANCE

Scope and Operation of the Workmen's Compensation Laws of the United States. *Lindley D. Clark*. U. S. Bur. Labor Statis., Month. Labor Rev., April, 1920, 10, No. 4, 14–32. — A questionnaire of the British government on the subject of compensation to workmen for injuries was submitted to the Department of Labor for information as to conditions and results under the laws of the various states. The questionnaire is a very comprehensive one, and includes questions about the scope of the system, its character, different methods of insurance, organization of state funds, organization of mutual associations, cost of compensation, benefits, malingering, the determination of claims, contemplated or demanded changes, voluntary insurance of persons not subject to compulsory insurance. Under each of these headings a condensed statement of the results of the inquiry is made. The data are necessarily too detailed to summarize, but such findings as the following may be mentioned.

The occupations and industries included vary in the laws of the forty-two states having legislation on the subject, some laws being enactments covering practically the whole body of industrial activities, while in others there is a limitation to hazardous employments or extra-hazardous employments. Domestic and farm labor is very generally excluded. Industrial or occupational diseases are specifically covered by the laws of but three states — California, Connecticut, and Wisconsin.

No general statement can be made of the reasons why systems vary as they do in the forty-two states having compensation laws.

A state fund exists in seventeen states, being exclusive or monopolistic in eight and competitive in nine. Where the fund is not exclusive, insurance may be carried by either private or mutual companies.

The administrative methods of each state fund are prescribed by the statute creating the fund. In the majority of cases a board or commission of three persons has charge of the fund as well as of the making of awards and the settlement of disputes. In a few states administrative expenses are borne in whole or in part by the state, but the tendency appears to be to make the system self-supporting.

The benefits paid usually amount to from 50 per cent. to $66\frac{2}{3}$ per cent. of the wages earned at the time of the disability. Usually the same percentage of wages is paid regardless of the period of the disability.

Medical and surgical aid is included at the present time in practically all laws, though omitted from some in their first enactment. No state of the Union has thus far enacted legislation providing for sickness or invalidity insurance.

The main results of the study are conveniently arranged in tabular form. — G. E. Partridge.

Medical Aid under the Compensation Act. *Chesla C. Sherlock*. Am. Machinist, Nov. 4, 1920, 53, No. 19, 844–846. — The attitude of the law toward the subject of medical aid for industrial workers is, in general, quite well defined. The author covers such matters as the rights of employer and workman in choosing a physician, the law regarding operations, the changing of physicians and the amount of expense for medical aid. — G. M. Fair.

Wounds of the Head and Compensation Laws. *C. L. Dana*. Arch. Neurol. and Psychiat., Nov., 1920, 4, No. 5, 479–483. — About 15 per cent. of the applicants for workmen's compensation in New York State complain of nervous symptoms, and a great many of these have received wounds of the head. They tell stories which are startlingly similar. Their syndrome is: headache, vertigo, insomnia, irri-

tability, anxiety, depression, memory defects, fatigability, tinnitus, partial deafness and loss of weight. About 10 per cent. of these cases are just made uncomfortable by their symptoms; in over 50 per cent. the patient is so worried and depressed that he cannot concentrate, and refuses to work; the remaining cases are of those who at first show no symptoms, but who later develop the syndrome after suggestion from sympathetic friends, still later exaggerating and becoming malingerers.

The psychology in most cases is simple. Most of the patients are dull, ignorant, and do not appear to have organized subconscious mechanisms. They are uncomfortable, suffering, apprehensive, hopeful of getting a sum of money, or perhaps enjoying idleness for the first time.

The conclusions are that the compensation laws should be modified so that the patient would receive early neurologic advice and treatment. — S. Cobb.

Compensation Table for Visual Losses of One Eye. *F. Allport.* U. S. Bur. Labor Statis., Month. Labor Rev., April, 1920, 10, No. 4, 187–188. — The old Snellen test type fractions are recognized everywhere as misleading; for instance, 20/40 does not mean a one-half loss of vision, nor 20/50 a three-fifths loss, and yet this is the method of estimating lost vision prevailing in the courts. The Chicago Ophthalmological Society has recently adopted a table representing its official opinion as to what constitutes a fair basis of settlement of visual losses in one eye following accidents, etc. The table (abridged) follows:

20/20 indicates no loss of vision.					
20/30	"	5.5 per cent. loss of vision.			
20/40	"	11.0 per cent.	"	"	"
20/50	"	16.5 per cent.	"	"	"
20/60	"	22.0 per cent.	"	"	"
20/100	"	44.0 per cent.	"	"	"
20/150	"	71.5 per cent.	"	"	"
20/200	"	90.0 per cent.	"	"	"

If the vision is worse than 20/200, industrial blindness is regarded as complete. — G. E. Partridge.

The Legislation Concerning Industrial Accidents Extended in France to Include Saturnism and Mercurialism. Il Lavoro, Aug. 31, 1920, 12, No. 4, 112–115. — The law of 1898 in France providing compensation for industrial accidents was extended in October, 1919 to cover industrial lead poisoning and industrial mercurialism. All of the industries are enumerated in which these two metals and their compounds are encountered by the workman. — A. Hamilton.

Determination of the Reduction in Occupational Efficiency of War Cripples. *Karl Meixner.* Wien. klin. Wchnschr., May 13, 1920, 33, No. 20, 428–429. — Any scheme attempting to set down in percentages the degree of occupational disability is wrong in that the degree of injury in any single case remains unprovided for. If the percentages represent average values, what can they signify when the range may be between zero and 100 per cent.? The loss of a finger to a flute-player may be vital from the occupational standpoint, while to a laborer or a blacksmith such a loss would be practically insignificant. — Barnett Cohen.

Disabilities as Aggravated by Pre-existing Conditions. *John W. Mowell.* Proc. 6th Ann. Meeting Internat. Assn. Indust. Accident Boards and Commissions, U. S. Bur. Labor Statis., Bull. No. 273, Aug., 1920, 220–228. — Many workmen possess physical or pathological handicaps which are aggravated by occupational mishaps and which may often be contributory causes to accidents. These conditions are divided for convenience into three classes: (1) congenital defects; (2) handicaps due to previous injury; (3) disease existing in the individual prior to the accident which causes him to apply to a compensation commission for relief.

Under (1) are mentioned all forms of defective vision, defects of hearing, skeletal deformities, patulous inguinal canal, and unstable nervous temperament. In claims for compensation where these defects are present, it is hard to delimit the amount of injury actually due to the accident. Under (2) permanent partial disability due to previous injury is pretty well defined and usually readily determined. Under (3) all kinds of pathological conditions may be present in the workman. If he is injured in an accident he may claim that the prior pathological condition was due to or accelerated by the accident. Such conditions must prevail until there is in the office of the compensation commission a record of the physical examination of every workman and until there is a requirement that a general physical examina-

tion be made at stated intervals and that a record of this be filed with the commission. Then will it be possible to separate the conditions which the individual had before his injury from the results of accident itself. — Barnett Cohen.

Employees' Emergency Insurance Organizations. Nat. Assn. Corporation Training Bull., Nov., 1920, 7, No. 11, 514–517. — "A description of a plan which has been tried out in a large organization whereby employees co-operate through a mutual insurance plan to provide ready money in case of death of the wage earner." The association described is a voluntary association maintained by employees without assistance from the company, and without payment of salaries to officials. A fund is accumulated automatically by the payment of small entrance dues, and an assessment in case of the death of one of the members. The sums yielded in these cases have been relatively large, and the association is regarded as practicable and successful, and is especially recommended for its simplicity of operation. — G. E. Partridge.

REHABILITATION OF DISABLED EMPLOYEES

Present Status of Industrial Rehabilitation. Vocational Summary, Oct., 1920, 3, No. 6, 84–86. — "Since the 2nd of June, when the President signed the Industrial Rehabilitation Act, industrial rehabilitation has become a fact, and persons injured in industry or otherwise now have a distinct claim upon the Government." Vocational rehabilitation includes the idea of restoration and elimination of vocational disability of whatever origin, whether of disease or of accident or of inheritance.

Some definite action leading towards the vocational rehabilitation of disabled persons has been taken in twenty-four states, and, of these, twelve states had assumed some responsibility for the rehabilitation of the disabled before the federal act made federal aid possible. The original plans differ in different states, and may need in some cases to be altered to meet the requirement of the federal act. In many of the states the industrial accident board or commission has been designated as the administrative agency. One state has given the work into charge of the department of public welfare and the workmen's compensation bureau, and the department of labor has been named in other states. Four states named the state board for vocational education. A plan for co-operation between the state board for vocational education and the board or agency administering the workmen's compensation law is a definite requirement of the federal law.

Money has been appropriated by twelve of the states, to be used in the work of rehabilitating the industrially disabled. Some state acts have authorized the use of existing institutions, while a few have provided for the establishment of special schools.

A brief statement of the progress of vocational rehabilitation in each state in which such progress has been made is appended to the general report. — G. E. Partridge.

Reclamation of the Physically Handicapped. *Harry E. Mock.* Jour. Am. Med. Assn., Nov. 20, 1920, 75, No. 21, 1406–1409. — The duty of the physician does not comprehend simple healing of the patient but also returning him to the best degree of usefulness.

"Statistics show that annually 875,000 men and women are disabled for more than four weeks as the result of accidents sustained in industry; that annually 76,000 people suffer loss of members, and at least 200,000 are otherwise permanently disabled by these industrial accidents, and that 28,000 of our people are annually killed by industrial accidents.

"Because of the nonreporting of occupational diseases, it is impossible to obtain statistics; but it is conservatively estimated that at least 250,000 more people are annually permanently disabled as the result of occupational diseases, and the deaths from these reach into the tens of thousands. Thus, the total number of permanently disabled from industry can be placed at half a million."

Certain of the author's conclusions give his general conception of the way in which this vast horde of injured should be handled.

"The knowledge that more than three times as many men and women were being disabled in industry annually as were disabled in our entire army has awakened the nation's conscience to the need of rehabilitating these unfortunates and of preventing such a casualty list.

"In different parts of the country, volunteer

and governmental agencies are endeavoring to solve this problem.

"A reclamation service to be complete must combine the efforts of medicine, education and industry. It must include the following services:

"(a) Prevention of accidents and disease.

"(b) Improved hospital, medical and surgical services. As an adjunct to these there must be provided better convalescent care.

"(c) Vocational training of the handicapped when needed.

"(d) Proper placement of the physically and mentally handicapped on jobs where they can be efficient with 'safety to themselves, to their fellows and to property.'

"(e) Their continued supervision until assured that this reclamation service is completed in every instance." — C. K. Drinker.

Women and the Industrial Rehabilitation Act. Vocational Summary, Oct., 1920, 3, No. 6, 86–87. — The industrial rehabilitation act applies equally to men and women, and the term "persons disabled" is interpreted to include all persons who, by reason of a physical defect or infirmity, whether congenital or acquired by accident, injury, or disease, are or may be expected to be partially or wholly incapacitated for remunerative occupation.

The number of women in industry signifies the need for provision for their vocational rehabilitation; twelve million is a conservative estimate of the present number, or about one-third of all persons in the country who are gainfully employed. Besides the women engaged in occupations included above, there are 25,000,000 women and girls over 10 years of age occupied in their own homes, and among them are women disabled by disease or through injuries of childhood who should receive the benefits of vocational training.

The small percentage representing the number of accidents to women, as shown by the statistics, should not be regarded as an indication of a lack of need for their vocational rehabilitation. Industrial accidents reported are largely those referred to in compensation laws, and women workers have not yet been included to any great extent in the provisions of compensation legislation. Moreover, workmen's compensation laws do not cover domestic service which until recently included about one-third of employed women — nor do they include agriculture which (except in New Jersey and Hawaii) engages approximately a fourth of women workers. Another fact, of a different character, affecting the statistics, is the natural caution of women; the reduction of the number of accidents in some plants since the employment of women has been so great that women have been retained as workers instead of men.

The appointment of a woman as supervisor of the rehabilitation of women in each state should be encouraged. The success of the work of industrial rehabilitation depends upon the degree of personal effort expended, and the consideration given to each case, and women possess special qualifications to meet these requirements. — G. E. Partridge.

State to Expand Rehabilitation Work. Hosp. Management, Sept., 1920, 10, No. 3, 56–57. — The first state rehabilitation clinic established in the United States for the treatment of men and women injured in industrial pursuits has been functioning for several months in Newark under the direction of the New Jersey Rehabilitation Commission. Physical reconstruction and vocational rehabilitation are the primary objects aimed at by the commission. The work of the clinic is essentially diagnostic and reconstructive, since it is conducted principally for ambulatory and short convalescent operative cases. The work of the commission and its clinics does not stop with reconstruction; it attempts through placement officers to find suitable occupation for those who come under its care. — L. A. Shaw.

The Blind in the Metal-Working Industry. Indust. Management, Oct., 1920, 60, No. 4, 314. — This editorial calls attention to the development of employment for the blind in skilled or semi-skilled operations in Cleveland. At the present time there are eighty-one blind men and women working in forty different plants. These people have gone into industry on the same basis of wage payments and other conditions of employment as their fellow workmen who see. The types of work at which they are employed include assembling, bench work, etching, inspecting, operating drill presses and other metal-working machines, packing, stacking, straightening, taping, etc. — C. H. Paull.

ABSTRACT OF THE LITERATURE

OF

INDUSTRIAL HYGIENE

VOLUME II | APRIL, 1921 | NUMBER 12

CONTENTS

GENERAL

AFTER-THE-WAR LABOUR CONDITIONS AND FACTORY PERSONNEL. *T. Oliver.* Jour. State Med., Aug., 1920, 28, No. 8, 229–235. — Some difficult problems of industry have risen after the war. The situation is made more difficult because of the thousands of disabled men needing rehabilitation. Great Britain has undertaken to provide for the training of those disabled in the war, but this offer needs to be extended to those who have been injured in industrial work — an obligation already foreseen before the war by Denmark and by Belgium. There is need of thorough investigation of the question of production with reference to length of periods of work and of the determination of hours of labor for each occupation, following results such as those already obtained by Fromont at Engis before the war. Fromont, for example, showed that in the case of zinc smelters as much work was done in a seven and a half hour day as had previously been done in a ten-hour day. It may safely be said that the day is past when long hours are regarded as consistent with the greatest production, and the day has come when all industrial work must be regulated in accordance with the physiology of fatigue and with the principles of the new science of industrial physiology. — G. E. Partridge.

CHRONICLES OF SOCIAL HYGIENE: INDUSTRIAL HYGIENE. *A. Elster.* Öffentliche Gesundheitspflege, 1920, 5, No. 2, 61–69.—Brief summary of the reports of the Prussian Labor Bureau for the war years shows that during the first two years conditions were favorable—indeed, the figures for sickness diminished because the workers forgot small illnesses for their country — but, from 1916 on, sickness increased. The chief affections were digestive diseases, nerve weakness and irritability, and skin diseases, especially furunculosis. There was much fainting in women, and even in men, and the workers appeared to be thinner and paler than usual. The principal causes assigned for increase in sickness were: the employment of weak workers, especially women and children, long hours, poor food, exposure to industrial poisons, lack of protective devices, small number of doctors, and the prevalence of influenza, particularly in 1918.

The Saxon reports show a decrease of accidents at first, with a rise after the revolution. The large number of women workers were more

careful than the men, but the children were very thoughtless. In the textile industry trouble was less, but in machine and metal work accidents were increased. Some severe explosions in munition factories led to strict regulation of the making and storing of explosives. The poor potato crop of 1916 was followed by the "cabbage winter." This and the lack of soap endangered the health of the workers.

In Württemberg there was a steady increase in the number of cases of sickness among the workers from 1914 to 1917. The chief diseases were colds and indigestion, and anemia in the women.

The Austrian legislature had presented to it a bill concerning labor of women and children in the fall of 1918. On May 14, 1919, a law was made forbidding night work, except in those trades which by their nature required it. On the next day a law was made regulating the rest time in stores and banks.

On November 22, 1918, an eight-hour day law was made; then the time in bakeries and confectioneries was limited to nine hours, the Sunday rest from 5 P.M. to 9 A.M. was legalized, and more protection was given to youth. In October, 1919, the Prussian legislature turned down a bill for the reform of industrial hygiene which provided for the appointment of doctors trained in hygiene as officials.

This brief outline of legislation gives some idea of the progress of industrial hygiene in Germany, but a better indication is given by a glance at the suggestions made by Germany for the labor section of the peace treaty. Articles 387 to 427 of that document are concerned with the formation of an international labor court and with the statement of general principles, such as the eight-hour day, living wage, right to organize, etc. But Germany wished to go more into detail, as follows:

1. All states are to be obliged to formulate laws for hygiene in all kinds of trades, and especially concerning accident and sickness insurance.

2. Effective directions are to be given for the protection of workmen in dangerous trades.

3. The use of industrial poisons is to be stopped as far as possible.

4. A special international law for seamen is to be worked out in co-operation with the seamen's organization.

5. An eight-hour day for all workmen.

6. Women to work only four hours on Saturday.

7. The working age of children to be set at fourteen, with time off between fourteen and eighteen for continuation schools.

8. Women to be given ten weeks off at childbirth, six weeks to be after delivery.

9. Employers forbidden to give women work to do at home after hours.

10. Equal pay for equal work.

11. Night work forbidden, except in those trades which by their nature require it.

12. Weekly rest of thirty-two hours, and shifts regulated so that at least every third Sunday is free.

13. Home work to be regulated in the same manner as factory work.

14. Home work forbidden in trades that involve the handling of poisons or foods.

15. Home work to be stopped when certain contagious diseases occur.

16. Minors employed at home work to be carefully watched by doctors.

17. Employers of home workers to publish lists of workers and their pay: a minimum wage to be established.

18. Employers of more than five foreign workers: (a) to post the labor laws in their native tongue; (b) to see to it, at their own expense if necessary, that the workers know the common trade terms in the language of the country.

19. Protection of labor by a department chosen from labor; annual reports to be published, together with the norms of other countries.

20. Labor organizations to see to the actual carrying out of protection through their committees and officials. — H. G. Noyes.

POISONOUS HAZARDS AND THEIR EFFECTS: GASES, CHEMICALS, ETC.

Carbon Monoxide Poisoning from the Use of Petrol Engines: Some Experiences during the War. *D. Dale Logan.* Jour. State Med., Oct., 1920, 28, No. 10, 306–319. — The author recites various experiences demonstrating the need for extreme precaution in the management of air compressors in places dependent upon them for ventilation. Obviously,

a compressor driven by a gasoline engine and sucking up the exhaust from the engine will not deliver a healthful product to the ventilators leading to mines and galleries. But this is what actually happened under stress of war conditions. — Barnett Cohen.

The Possibility of Hydrogen Sulphide Poisoning in Tanneries. *Holtzmann.* Abstracted as follows from Zentralbl. f. Gewerbehyg., Dec., 1919, 7, No. 12, 214 by Holtzmann in Hyg. Rundschau, July 1, 1920, 30, No. 13, 409. — "Kalzin, a calcium sulphur compound, often used in tanneries with the slacked lime, whem mixed with acids leads to a violent evolution of hydrogen sulphide fumes, which have already exacted their sacrifices." — E. L. Sevringhaus.

The Conversion of Air into a Lethal Mixture of Gases by Storage of Tobacco and Other Vegetable Substances. *Robert C. Frederick.* Jour. Hyg., Oct., 1920, 19, No. 2, 205–207. — Under certain conditions and after elapse of sufficient time, tobacco stored in an unventilated space, provided there is 10 per cent. or more of moisture present, converts air into a mixture of gases entirely incapable of supporting human life. Laboratory tests in glass bottles showed a percentage of 49.95 carbon dioxide and 0.21 oxygen after eighteen days at 12 to 37° C. — Henry Field Smyth.

OCCUPATIONAL INFECTIOUS DISEASES: OCCURRENCE, TREATMENT AND PREVENTION

Investigation of Thirty-Four Cases of Human Anthrax Occurring in New York City during 1919 and 1920. *S. Dana Hubbard* and *William Jacobsohn.* Month. Bull. Dept. Health, N. Y. City, Nov., 1920, 10, No. 11, 249–266. — The authors present case histories of a series of thirty-four cases of human anthrax occurring in New York City during a period of twenty-one months in 1919 and 1920. It is shown that anthrax cases are increasing in New York City, there being more than four times the number of deaths in the five-year period, 1915 to 1919, than in the preceding five-year period, 1910 to 1914.

A summary of the 34 cases shows that 15 of the cases occurred in artisans handling infected material as follows: trucking (unloading, sorting, loading and counting hides and skins), 8 cases; manufacturing brushes (handling anthrax-infected hair), 5 cases; millinery (handling infected hair cloth and hair braid), 1 case; house cleaning (handling infected hair dust brush), 1 case. Seventeen of the cases resulted from using new, anthrax-infected shaving brushes. In two of the cases the mode of infection was unknown. Twenty-four of the cases were thus from contact with hair and 8 from contact with hides.

Treatment is discussed and the conclusion reached that seemingly the most successful treatment is the administration of anti-anthrax serum, 10 c.c. by local infiltration, every eight hours; and 40 c.c., intravenously, every four hours, without operation.

It is concluded that adequate disinfection of hides and skins, under expert supervision, at the place of origin, shipment, or receipt, is necessary to prevent future occurrence of anthrax among such handlers. Similarly sterilization of hair must be done before manipulation is permitted. Section 230 of the Sanitary Code of the Department of Health, requiring such proper sterilization, is quoted. — Henry P. Carr.

OCCUPATIONAL AFFECTIONS OF THE SKIN AND SPECIAL SENSES

Causes of Skin Sores and Boils among Metal Workers. An Investigation by the Houghton Research Staff. E. F. Houghton & Company, Philadelphia, 1920, pp. 51. — This is a comprehensive and illuminating study of a serious problem in industrial medicine. The conclusions reached are as follows:

"1. The infection is bacterial.

"2. The bacteria, or germ, is not present in the oil, no matter of what variety or character the oil may be, but exists on the human body.

"3. The germ has no power to create a boil or sore until it has secured ingress to the skin;

or until the skin is broken or some means arise by which the bacteria can attack the flesh.

"4. All cutting oils have skin penetrative powers. This property of penetration is due to the high thermal conductivity of such oils; i. e., their ability to convey heat from the point of generation to the atmosphere. The oils can therefore penetrate the skin, and they do actually penetrate through the pores.

"5. They penetrate the skin of hairy persons much more readily than the skin of those who are devoid of hair, because hairy skins are more vulnerable through their superabundance of capillary pores.

"6. The oil, in penetrating the skin through the pores, carries with it the bacteria which exist naturally on the surface of every living body.

"7. The bacteria also secure entrance to the skin through minute punctures made by metal chips which are carried in solution by the oil to the human body. Many of these chips are so minute as not to be discernible to the naked eye.

"8. These epidemics of boils are more prevalent in hot weather, or under heated working atmospheres, than in cool weather and under cooler working atmospheres.

"9. The sores are not always precisely similar and the bacteria are not always the same.

"10. Sore-producing bacteria have been found in oil, but only in oil which has been used at least once, and not in the fresh oil as it is received from the manufacturer.

"11. The breeding of such bacteria has been traced to unsanitary conditions existing in the establishment where the oil is used. It has been found that workmen often expectorate into the oil as it passes through the machine, spit into the oil tanks, throw garbage or other filth and refuse into the oil, and otherwise contaminate it while it is in use.

"12. Some oils encourage this bacteria breeding, when contaminated, to a greater extent than others. The worst offenders are the oils commonly known as 'paraffine oils.' It must not be inferred that we mean paraffine base oil, or oils made from paraffine base crude. The distillates from paraffine base crude are among the oils least culpable in this respect. These paraffine oils, which are the most favorable culture media, are the ones produced in the process of pressing paraffine wax. The actual difference between these bacteria-carrying paraffines and the other paraffines is that the former are oils pressed from residuum matter while the others come over the still in the distillation.

"13. The most practical preventive of these epidemics of sores is cleanliness on the part of the operatives. The operatives should be instructed to wash up with pure soap; to avoid the very common practice of smearing the body with oil before washing, and to wash as frequently as possible. They should wash every four or five hours on the average and at noon as well, and before supper when they work overtime, as well as when they quit work. They should be taught to change their clothing at least twice a week and wear clean overalls and working clothes. The overalls should be washed at the regular periods set by the time it takes a pair to become soiled. Soiled underclothing, linen and outside clothing help to deposit germs on the skin, foster their growth and aid them in penetrating the skin. When the clothing gets saturated with oil that is permeated with minute metal chips, the rubbing of the clothing allows the metal to abrade the skin, thus affording a place of ingress for bacteria.

"14. The skin of the metal-working operative is no more bacteria-infested than that of any other human being or worker. The metal operative is, however, more exposed to conditions which give the bacteria opportunity to get under the skin and do harm.

"15. The benefit to be derived by incorporating in the oil so-called 'disinfectants' or 'germicides' is negligible. It is a fact, however, that Carbolized Cosmoline, applied to the skin after washing, acts as a preventive of the bacterial infection in question. The carbolic acid content of this preparation, being of a germicidal nature, kills the germs, while the Cosmoline, being of the petroleum family, spreads an oleaginous film which protects the pores from impregnation. Carbolized Cosmoline is, nevertheless, not infallible as a preventive and will most likely fail unless hygienic, sanitary and cleanly precautions are taken. The oil must be protected against contamination of any kind. This includes the best and most modern methods of minimizing the amount of metal chips which are carried off in the oil.

"16. Epidemics of sores are likely to occur in any plant where metal-cutting is done with the aid of oil. Previous immunity from such epidemics is no guarantee for the future. It happened on several occasions during our first

inquiry that we were informed at a plant that no such thing as sores had ever been known there. Then, after a short time, we received from the same concern an inquiry as to how we were getting along with our investigation. They added that they were experiencing an outbreak of sores on their employees 'for the first time.'

"17. Oil plant workers, except those engaged in paraffine pressing plants, are not very susceptible to the infections in question. The Houghton employees, for instance, rarely experience sores and, when they do, the trouble can never be ascribed to the oil with which they come in contact, or to the bacterial infection above outlined and described in the following treatise. Neither has any other oil works that we know of ever had an epidemic of such bacterial infection or irritation due to oils, the paraffine oil pressing plants excepted. We found the epidemic to be quite common in the pressing plants of paraffine wax manufacturers."

Industrial physicians will do well to secure this very serviceable report from E. F. Houghton & Co. — C. K. Drinker.

Scleroderma as a Possible Manifestation of Chronic Arsenic Poisoning. *Samuel Ayres, Jr.* Arch. Dermat. and Syph., Dec., 1920, 2, No. 6, 747–756. — (*Review by author.*) In the above-mentioned issue of the *Archives of Dermatology and Syphilology* four consecutive cases are described of scleroderma with traces of arsenic in the urine. Since the submission of this paper two additional cases have been found also showing arsenic in the urine. So far as I know this is a new finding not described in any available literature, during at least the past twenty years. It is not claimed that the etiology of scleroderma has been discovered and I wish strongly to emphasize that I am not urging any such ideas. I wish merely to present the facts which have been developed and let them speak for themselves, supported or rejected by whatever evidence the future may bring.

The original suggestion of testing the urine of a scleroderma patient for arsenic was made by Dr. William H. Smith, visiting physician on the West Medical Service of the Massachusetts General Hospital, Boston, in the case of H. E., a young American, thirty-five years old, who had been foreman in a paper-box factory for ten years, and rather constantly exposed to paper dust resulting from the cutting and trimming of paper and cardboard.

This patient presented the typical picture of a moderately advanced case of diffuse scleroderma of about one year's duration, the hands and forearms showing the greatest involvement, with almost complete fixation of the fingers in a semi-flexed position. The face, chest, and abdomen were involved to a less extent. The affected skin showed the characteristic brown pigmentation, glossy appearance, and was so firm and hard that it could not be pinched up in the slightest degree. The palms were nearly always wet with perspiration and were tender to the touch. Earlier in the disease the hands and sometimes the feet were frequently swollen, were often very sore and tender, and the fingers sometimes white, sometimes cyanotic. There had been practically no constitutional symptoms except for insomnia during the past month. At our request he brought three samples of paper and one of cardboard to the hospital for chemical analysis. The cardboard and two of the samples of paper gave positive tests for arsenic.

Five of the cases in the series reported were patients at the Massachusetts General Hospital, and the urine tests for arsenic, all of which were positive, were done in the chemical laboratory of the hospital under the direction of Dr. W. Denis. The sixth case was a private patient of Dr. Richard L. Sutton and the arsenic test was done by the Kansas City Testing Laboratory. Five cases were of the diffuse variety of the disease, one was of the localized or "morphoea" type. Three cases gave clean-cut histories of exposure to arsenic: one was the foreman in the paper-box factory; another was a Russian Jewish housewife who kept a little grocery store in a damp basement and who for the duration of her disease — four years — had kept an open saucer filled with powdered arsenate of lead under her counter to kill mice; the third was a young school teacher who used arsenical sprays in her capacity as director of school gardens.

The possible sources of arsenical poisoning are quite varied. The character of the arsenic which gains entrance to the system is a large factor in its toxic manifestations, arsphenamine under proper conditions being ordinarily non-toxic, arsine gas even in minute amounts being highly poisonous. Individual idiosyncrasy is another important element.

The symptomatology of diffuse scleroderma

and chronic arsenic poisoning in individual cases show a marked parallelism which apparently has not been generally recognized. Symptoms such as the following are common to both diseases: neuritic manifestations; pigmentation, cutaneous alterations of various kinds; loss of weight, strength and appetite; gastro-intestinal disturbances such as pyrosis, abdominal cramps, sore tongue; intermittent, irregular fever; vaso-motor instability, rapid and irregular heart; menstrual disturbances; hoarseness, salivation, etc. Osler described eight cases of scleroderma in the *Journal of Cutaneous Diseases* in 1898. Many of his patients had severe constitutional symptoms suggestive of those seen in chronic arsenic poisoning. In the epidemic of arsenical beer poisoning in England, Brooke and Roberts in the *British Journal of Dermatology* for April, 1901, describe among the commonest initial symptoms, soreness, redness, and swelling of the palms and soles. These are commonly the early manifestations of scleroderma.

If the future should establish chronic arsenic poisoning as an etiology of scleroderma, the following facts may account for the failure in the past to have connected the two processes: (1) the rarity of both diseases; (2) inadequate history in regard to exposure to arsenic in cases of scleroderma; (3) failure to recognize scleroderma, many cases doubtless passing for "rheumatism" or Raynaud's disease; (4) the possibility that scleroderma may be a specialized manifestation of chronic arsenic poisoning and occur independently of other symptoms just as the gastro-intestinal symptoms may for a long time be the only evidence of pellagra.

J. J. Putnam in the *Boston Medical and Surgical Journal* in 1890 found traces of arsenic in 43 per cent. of forty-eight urines selected at random, and very properly concluded that the mere presence of arsenic in the urine was not enought to account for doubtful symptoms, but he also emphasized the fact that the absence of arsenic from the urine did not exclude arsenic poisoning, inasmuch as arsenic was excreted only intermittently, and had not been found in the urine in some cases of acute fatal arsenic poisoning. One of our cases gave two negative tests at two week intervals, and then a positive test after taking a saturated solution of potassium iodide, 10 drops three times a day for eighteen days. It is possible that the potassium iodide liberated the arsenic from the tissues, but this is only a surmise.

Treatment of scleroderma is notoriously unsatisfactory. Heat and massage are somewhat palliative. Thyroid medication has been distinctly disappointing. We have used quartz light therapy but insufficient time has elapsed for definite conclusions. The underlying pathology is a connective tissue hyperplasia with secondary atrophy, including vascular obliteration.

These are the facts, and as before stated they are offered not in any sense as proof, but as indicating a possible line of investigation. — Samuel Ayres, Jr.

The Economic Aspect of Miners' Nystagmus. *T. L. Llewellyn.* Jour. State Med., Aug., 1920, 28, No. 8, 236–256. — The average time of eye failure in a series of 1500 cases was forty-one years. The average period of underground work before failure was twenty-five years. About 75 per cent. of the men examined had errors of refraction, and the disease was found so frequently to follow an accident that the connection between the two seems to the writer to be well established. Sometimes the onset of the disease was sudden, but generally a period of twelve months elapsed between the onset of the disease and the final failure.

It is now generally admitted that deficient light in the coal mines causes miners' nystagmus, and the problem of prevention of the disease is bound up with the improvement of illumination underground. In this respect, the conditions are still very bad, since it is safe to say that over 90 per cent. of all the lamps in general use give less than 1 candle-power at the coal face. The greatest improvement has come from the introduction and development of the electric lamp which at present gives from 1 to 1.5 candle-power. With the cap lamp the light is brought so much nearer the working area that the illumination obtained is two or three times as great as that obtained from the ordinary type of oil or electric lamp of the same candle-power. As regards maintenance cost, per shift, of the lamps, Deike gives: for oil or carbide lamps, 6 to 7 cents; sperm candles, 7 to 8 cents; electric lamps, 3.5 to 5 cents. Another help in increasing the light in the mine is whitewashing the pit bottom and the main roads.

Other conclusions reached by the author are: that ill health and mental stress accelerate the onset of the disease and that there is some evidence for hereditary predisposition; that medical examination before engagement might

eliminate many cases; that most cases are convalescent in six to twelve months and free from all symptoms in one or two years; that in the chronic case the mental factor is of great importance; that the economic losses from the disease and the ineffective handling of it and its consequences are very large; that the method of certification for disability should be revised. G. E. Partridge.

Coal Miner's Nystagmus and its Predisposing Causes. *A. J. Martin.* Brit. Med. Jour., Nov. 27, 1920, 2, No. 3126, 814–815. — A comparison is made of the similarities of miner's nystagmus and the anxiety neurosis of war-strained individuals, and it is the author's opinion that both are essentially diseases of exhaustion. He discusses the signs and symptoms of miner's nystagmus and then classifies the predisposing causes as follows:

1. Nature of the work done. Stallmen (88 per cent. of all cases) have great strain on the eyes, and a great responsibility as they are responsible for the lives of their fellow workmen.
2. Excess of alcohol and tobacco. Nystagmus is often worse on Mondays and after holidays.
3. Illness. Several cases followed influenza.
4. Accidents, especially accidents to the eye.
5. Heredity. The tendency to the disease is transmitted as readily by the mother as by the father.
6. Exhaustion, due to want of food, and prolonged strain without rest, the author believes to be the most important, most effective predisposing cause of the disease. Since the Eight Hours Act, he feels that the disease is more common, and as an explanation he suggests that the shorter time allowed for lunch — fifteen minutes — may be a factor. He advocates that the lunch time be increased to at least forty minutes. — J. T. Wearn.

Miner's Nystagmus: Suggestions for its Prevention. *D. Lechmere Anderson.* Brit. Med. Jour., Nov. 27, 1920, 2, No. 3126, 813–814. — The author states it as his belief that no man, the refractive condition of whose eyes is normal, will develop miner's nystagmus to such an extent as to incapacitate him from miner's work. The author then classifies the causes of nystagmus as follows: (1) *predisposing:* (a) errors of refraction associated with the conditions of a collier's work; (2) *exciting:* (a) presbyopia, (b) defective illumination. Heredity may play a part only so far as refractory errors are hereditary. He then recommends as means of prevention the careful examination of the eyes of all applicants for miners' positions, and suggests that if the error of refraction exceeds 1 diopter hypermetropia or myopia, or if astigmatism is present, the man should be excluded from work as a coal miner. — J. T. Wearn.

Abstract of Report on Eye Injuries. *Francis D. Donoghue.* Boston Med. and Surg. Jour., Nov. 4, 1920, 183, No. 19, 558–560. — Normal central visual acuity is not normal vision. One-tenth of normal vision does not mean one-tenth of normal central visual acuity alone. The object is to simplify for industrial compensation boards the administrative procedure in regard to eye injuries by broad interpretation and definitions. Consequently, there is given a definition of normal vision expressed in terms of ability to correctly interpret form at infinity. The test object and illumination are specified, and the examination methods enumerated. A statement is made of what is considered one-tenth of normal vision. — Barnett Cohen.

OCCURRENCE AND PREVENTION OF INDUSTRIAL ACCIDENTS

The Incidence of Industrial Accidents upon Individuals with Special Reference to Multiple Accidents. *Major Greenwood* and *Hilda M. Woods.* Reports of the Industrial Fatigue Research Board, No. 4, London, 1919, pp. 28. — This is a painstaking study, by a statistical method, of the factors involved in the production of industrial accidents. The authors' problem is to discover, by means of the distribution of multiple accidents in groups in which general liability is uniform, whether accidents occur solely by the principle of chance, or whether individual liability to accident can be detected, in the occurrence of repeated accidents. The mathematical analysis is too complicated to be made clear in a brief abstract, but the main results may easily be indicated. The form of distribution of the items sustains the hypothesis that there is a decided difference in initial liability to accidents on the part of the individuals appearing in the groups studied. This varying individual sus-

ceptibility is, in fact, so important a factor that "given the experience of one period, it might be practicable to foretell with reasonable accuracy the average allotment of accidents amongst the individuals in a subsequent period."

The question is raised whether from the statistical materials anything more can be derived than confirmation of the popular opinion that there exist both careful and careless periods — whether accidents actually are a function of output, etc. The result, so far as the data of the study reported are concerned, is that the differentiation of those who do, from those who do not have accidents cannot be shown to be related to a similar differentiation in regard to output. Those who sustain many accidents are, on the average, neither more nor less productive than their fellows. There is some indication that time lost through sickness is negatively correlated with accidents, but not much significance is attached to the numerical result obtained. Nothing definite or important was found in trying to estimate the correlation between age and accidents.

The article contains thirty tables, a page of mathematical formulas, and some references to other work of a similar nature. — G. E. Partridge.

The High Cost of Things that Happen Unexpectedly. *Sidney J. Williams.* Factory, Oct. 1, 1920, 25, No. 7, 1043–1045. — This discussion looks upon accidents as signs of wasteful procedure. "Accidents in the broad sense are the exact reverse of efficiency whether the accidents injure anyone or not." The writer chooses to ignore completely the effects of accidents upon individuals, looking upon them purely from the standpoint of production. The falling of a casting from a truck on the foot of a workman leads one to believe that the construction of the truck or the method of loading has resulted many times previously in castings falling without injuring the worker. In each case there has been time lost in replacing the casting, assuming that no other loss has been involved. In another case where dust hazard resulted from a certain operation, causing lost time and a decrease in the efficiency of workers, a mechanical adjustment eliminated the dust in the room and saved enough dust to pay 35 per cent. a year on the cost of the change. — C. H. Paull.

Reducing Accident Risks. Factory, Oct. 1, 1920, 25, No. 7, 1068–1074. — Among the suggestions given under this heading are four which are of particular interest. In the Kimberly-Clark Company and the Neenah Paper Company a safety campaign was conducted in which the responsibility for accidents was placed squarely on the foremen. A careful tabulation was made of accidents by departments. During the first six months the number of accidents was reduced from 135 for a corresponding period the previous year to 53.

In a plant where there had been considerable accident risk through rushing to exits at quitting time, a system was inaugurated by which workers from various departments formed lines and marched out in regular order. Not only was the accident hazard eliminated but workers were able to leave the plant in a shorter time.

Under caring for equipment, extracts are given from rules formulated by the Western Pennsylvania Division of the National Safety Council regarding the care of welding equipment.

At the Gilbert and Barker Manufacturing Company plant monthly prizes are given to employees making safety suggestions. At the entrance to the plant is a large sign bearing the words "Be Careful To-day." Each employee upon entering the plant faces this sign. — C. H. Paull.

Something to Crow About. Factory, Nov. 1, 1920, 25, No. 9, 1400. — This article discusses briefly a plan inaugurated by the International Harvester Company for developing competitive interest in the reduction of accidents. Careful records are kept of lost-time accidents in all departments of factories included in the organization. In departments having no accidents posters are placed at the end of the month with the heading "Something to Crow About." In a department where lost-time accidents have occurred a poster is placed with the heading "Nothing to Crow About Here." This second poster asks for recommendations for the reduction of accidents in the department. — C. H. Paull.

INDUSTRIAL PHYSIOLOGY: NUTRITION, METABOLISM, FATIGUE, ETC.

Lung Ventilation with the Use of Gas Masks. *H. Dreser.* Vrtljschr. f. gerichtl. Med., Jan., 1920, Third Series, 59, No. 1, 54–81. — The dead space, formed by the volume of the respiratory passages, becomes a larger factor in the productivity of a single respiration as the respiratory volume decreases, necessitating more rapid respiratory movements. This condition is simulated if the physiological dead space is increased by having an individual breathe through any apparatus. Marked air hunger is produced if this additional volume is large enough — the "tube dyspnea" of Gad. If this effect is to be avoided in breathing through any apparatus the expired air must be separated at the mouth from the inspired air. Experiments were made with German gas masks to determine whether the form or the volume was the determining factor for the composition of the air inside the mask.

The resistance to the passage of air through the absorption box was found to give rise to a difference of pressure between the air in the mask and the atmosphere, varying from 6–8 mm. water pressure during quiet respiration up to 24–30 mm. during very vigorous respiration. The capacity of the mask was 520 c.c. of air; that of the absorber, 241 c.c. Therefore, 761 c.c. were added to the physiological dead space in these German masks which had no valves to separate the air currents.

To get visual demonstration glass models were substituted for the masks, and ammonium chloride fumes were "breathed" by mechanical means. Using a small glass cylinder it was found that the whole volume of the tube had to be inspired before new air could be inspired, thus involving much rebreathing if the tube were large. With a glass funnel simulating a mask, the larger end covering the "mouth and nose," the fumes were exhaled and then inhalation was observed to secure a mixture of fumes and air from the small opening of the tube, thus involving some rebreathing. If the small end of the funnel were nearer the "mouth and nose" the amount of fresh air inspired was much greater. The Gad tube dyspnea experiment was tried with a subject breathing through a glass tube 5.5 m. long, with a diameter of 33 mm., and a capacity of 4700 c.c. Since vital capacity is about 3500 c.c. no air could possibly enter from the free end of the tube directly into the lungs. The free end was immersed in fumes of ammonium chloride, and, with respiration, the fumes were observed to pass back and forth in the tube with little mixing of air and fumes. The contents of the tube were aspirated from the mouth end for analysis, six successive portions of 500 c.c. each being used and a final portion of 1000 c.c. Respiration was maintained for intervals of $\frac{1}{4}$, $\frac{1}{2}$, 1, and $1\frac{1}{2}$ minutes before analysis. Longer than this was painful. The carbon dioxide content of the air samples nearest the mouth increased from 5.5 per cent. to 7.4 per cent. in the four intervals, and in each case dropped rather regularly toward the distal end of the tube. The concentration in the most distal sample was, however, always above normal for the atmosphere. Oxygen in the tube varied from 13.0 to 8.1 per cent. in the proximal samples, and from 20.8 to 17.8 per cent. in the distal samples. The cause of the intense air hunger which occurred at the end of one and a half minutes is said to have been the diminution in oxygen in the proximal part of the tube, since there was a more marked decrease in the oxygen than an increase in the carbon dioxide as the time of the experiment became longer.

Using a glass funnel, to the small end of which was attached an absorption box of a gas mask, two tubes, whose capacity is not stated, were arranged with valves, the one to permit inspiration from the "mask" and the other expiration to the mask. The capacity of the funnel and absorber together was 1800 c.c., twice that of the gas masks. It is calculated that with only the oxygen in the lungs and in the mask and absorber, discomfort from air hunger would occur in not over one and a half minutes. There was no discomfort from the use of this apparatus for five minutes, whence it is concluded that oxygen must enter the mask. After such use 100 c.c. samples were drawn from each tube, but it is not stated whether such sampling took only air from the tubes. The expiratory tube had 5.4 per cent. carbon dioxide, and 15.8 per cent. oxygen. The inspiratory tube sample had 2.7 per cent. carbon dioxide and 18.3 per cent. oxygen. Since this size and form of apparatus caused no serious diminution of oxygen, the gas mask of similar design but half as large is probably safe.

By an apparatus described at length, the equivalent total opening through the absorption box of a German mask was found to be 21 sq. mm., which is about one-sixth that of the wide open human glottis.

It is commonly accepted that the air to be respired ought to contain at least enough oxygen to support the combustion of a candle. A candle is extinguished at about 15 per cent. oxygen, although human respiration does not become uncomfortable until oxygen is reduced to about 10 per cent. A mask was fitted with an extra tube so that samples of air could be withdrawn for analysis. With a soldier sitting quietly and breathing regularly through the mask, samples of over 100 c.c. were drawn without attention to the phase of respiration. The carbon dioxide varied from 3.3 to 3.7 per cent., the oxygen from 16.9 to 17.5 per cent. When samples were taken during only one phase of respiration the variation was greater: expirations — carbon dioxide 2.8 to 4.1 per cent., oxygen 16.9 to 17.8 per cent.; inspirations — carbon dioxide 0.9 to 1.4 per cent., oxygen 19.3 to 19.6 per cent. Another series of inspirations, with a slightly different method, gave carbon dioxide 1.9 to 2.6 per cent., oxygen 18.3 to 19.0 per cent. A third series with a still different method of sampling gave carbon dioxide 2.2 to 3.2 per cent., oxygen 17.6 to 18.1 per cent. With an automatic apparatus for sampling, inspirations were carbon dioxide 0.6 to 1.4 per cent., oxygen 19.5 to 20.2 per cent.; expirations were carbon dioxide 2.4 to 2.8 per cent., oxygen 18.4 to 19.2 per cent. In this latter series the method gave samples with too high a proportion of air freshly drawn in from the absorber. The outer limits on all these samples were, thus, carbon dioxide 0.6 to 4.1 per cent., oxygen 16.9 to 20.2 per cent.

A better picture of what actually takes place is given by holding the breath at the end of a normal expiration. Samples aspirated from a mask at this point show what would have been breathed at the following inspiration. Successive samples taken thus showed decreasing content of carbon dioxide and increasing content of oxygen. The average percentages of carbon dioxide and of oxygen which might be thus inspired with an ordinary respiration were not studied. The limit of the concentrations was obtained by taking a sample while the breath was held following a normal inspiration, when carbon dioxide dropped as low as 1 per cent. Thus, in spite of the entrance of oxygen with fresh air in each respiratory movement, real fresh air was never breathed through the mask. There was probably some accumulation of carbon dioxide in the blood, but this was not considered dangerous. Oxygen in the mask was evidently never reduced so far as not to support combustion.

To determine the effect of a mask on the ability to do muscular work, a subject was placed in a sort of rowing machine where he did 234 kg.-m. of work in a three-minute period. When breathing through a mask it became difficult to hold to this pace, due partly to the accumulation in the mask of moisture from perspiration and breath. This difficulty was reduced when breathing through a glass tube direct to the exterior, but still wearing the mask.

The French and English masks are discussed. The French is considered little better, for its valves for intake and outlet do not separate the air at the mouth, moisture can accumulate, and carbon dioxide accumulates as in the German form. The English mask separates the two streams of air and keeps the inside dry, but in the four absorbers tested the valves preventing expiration through the absorber leaked so that even this form increased the dead space of the body, although the extent of this leak is not estimated. Other criticisms on the masks are mentioned. The separation of the two currents of air at the mouth and the exclusion of respired air from the interior of the mask are considered as desirable features in a mask. — E. L. Sevringhaus.

Industrial Fatigue. *A. F. Stanley Kent.* Jour. State Med., Sept., 1920, 28, No. 9, 261–273. — The term "industrial fatigue" has come to mean the condition of inefficiency found in industrial workers, whether due principally to the performance of mechanical work or not. It sometimes happens that symptoms similar to those of fatigue appear in an individual, or in a group of individuals, under circumstances where the task performed seems inadequate to explain them. The theory of fatigue which best explains these cases is that it is due in part to the using up of energy-producing material in muscle and nerve, and to a greater extent to a temporary poisoning of the muscles and especially of the nerves. We must recognize the fact that these fatigue-producing products may be formed in ways not connected with the output of energy — for example, by

processes occurring in the digestive tract. Other factors in fatigue are poor ventilation and noise. Vibration is another factor, important in the case of locomotive drivers, boiler makers, etc.

In many investigations of industrial conditions it is necessary to be able to estimate the effect of various factors — of work and of the surroundings of the worker — in terms of fatigue. The test of output fails, since output depends upon other variables besides fatigue, and may vary either with or against fatigue. Output is, however, affected by fatigue, and, where readings are taken over a sufficient length of time and from a sufficiently large number of persons, valuable indications may be obtained. The examination of sickness returns is important, for well-kept sickness returns form a valuable index of the general state of health of employees. Fatigue causes diminished resistance to disease, and this shows itself in the sickness returns. Records of lost time, and numbers of persons late are valuable indications. Accidents, also, are an index of the grade of fatigue present in the worker.

An analysis of records kept with reference to the output, etc., during two periods in an elastic webbing factory, leads to interesting results. During one period the working hours were $56\frac{3}{4}$ per week; during the other, $50\frac{3}{4}$. More persons were absent, and more time was lost when hours were long than when they were shortened. There were also, in the former period, wider variations as regards the number of persons late and loss of time on different days of the week, showing an unstable condition of the workers during the period of longer hours. The curve for the first period showed for Saturday a great increase in lateness and lost time. Whatever the cause, irregularity on Saturday ceased as soon as hours were shortened. But the records for Mondays, after the change, show relatively (as compared with other days of the week) more loss of time and lateness than before — a condition which, in the opinion of the writer, needs careful investigation, since it is evidently due to other factors than fatigue. The diminution of six hours a week, in the case considered, was sufficient to make a difference between "overload" and "not overload." As regards output, the shortened day was actually more productive than the long day. There was also a great decrease in sickness. — G. E. Partridge.

Smoking and Fatigue. *Paul Bartholow.* Editorial. Boston Med. and Surg. Jour., Nov. 18, 1920, 183, No. 21, 606–608. — The relations of smoking to fatigue are discussed in the light of the contradictory evidence emanating from all quarters. The relation of smoking and labor efficiency requires further investigation, and the starting point should be the actual conditions of the worker's life. Whether nicotine raises blood pressure or affects voluntary muscular action are facts, valuable no doubt, but obviously of little use in answering the main question definitely. — Barnett Cohen.

HAZARDS OF COMPRESSED AIR, DIMINISHED PRESSURE, GENERATION AND USE OF ELECTRICITY, AND ELECTRICAL WELDING

Protective Measures against Dangerous Contact in Plans for Low Tension Electric Wiring. *W. Vogel.* Electrotech. Ztschr., Sept. 23, 1920, 41, No. 38, 752–753. — The author suggests certain protective measures for low tension wiring of shops and factories. — G. M. Fair.

WOMEN AND CHILDREN IN INDUSTRY

The New Place of Women in Industry. *Ida M. Tarbell.* Indust. Management, Oct., 1920, 60, No. 4, 265–266. — Miss Tarbell calls attention to the unexpected accomplishment of women during the war. They were trained to be good machinists, in some cases were able to perform heavy work without apparent physical injury, proved themselves ingenious in the laboratory, and exhibited executive qualities in positions of managers, superintendents, foremen, and employment supervisors. In view of the contention that immigration will be limited both by a change of standards in this country and by the increased ability of European countries to retain their population, it is maintained that there will arise a greater need for women in industry than prior to the war.

It was feared that with the beginning of the war there would be a serious return to early methods of labor exploitation. This fear, however, seemed ungrounded, particularly in the case of England, France and the United States. The tendency was markedly in the other direction, and this was especially true in the case of women workers; so that standards for the employment of women were greatly benefited by the war. There still remains, however, a task which industry itself can do much in accomplishing in the way of developing higher and better standards for the position of women, who, Miss Tarbell feels convinced, will continue to remain in industry in large numbers. Further improvement of standards will be of value not only in this country, but also in less progressive countries, such as Japan, where our codes may well serve as a basis for improving the condition of women workers. — C. H. Paull.

A Nutrition Class for Working Children in Chicago. *M. J. Roberts* and *Anna Boller*. Mod. Med., Oct., 1920, 2, No. 10, 664–667. — This article is a report of an attempt to meet the common need for the supervision of the physical welfare of growing children. Infant welfare work has already accomplished much in the way of reducing mortality at early ages. The Children's Bureau investigation in 1919 has emphasized an even greater problem in older growing children, especially those who are obliged to work.

Chicago finds its most effective agency in the Vocational Guidance Bureau of the Board of Education which, as one of its functions, serves as a clearing house for all working children who are below a certain standard of physical fitness. The method of this agency consists in first making each child aware of his physical defects as well as of errors of diet and habits; and then helping him to help himself.

In a class conducted as part of the Industrial Clinic at the Rush Medical School, 133 children, all sent by the Vocational Guidance Bureau, made 951 visits during the first eight months of the clinic. The proceedings of each session comprised instruction in the elements of diet, sleep, clothing, physical training and other matters of general hygiene. As a preparation for effective instruction a supper of substantial food was found a practical necessity. Corrective measures included some of the more simple forms of surgical treatment such as that of tonsils or teeth, as well as exercises for general development.

Records of six children, all workers selected from this class, are reported with diagrams showing weight changes. The charts cover periods varying from twelve to thirty-four weeks. In most instances the underweight percentage is decreased by at least one-half during the period of attendance. — H. W. Stevens.

SUBJECT INDEX TO VOLUME II

This is a subject index to all the reading matter in the ABSTRACT OF THE LITERATURE OF INDUSTRIAL HYGIENE and one should, therefore, look for the subject word. The name of the author follows the subject entry in parentheses.

For author index, see page 237.

AUTHOR INDEX TO VOLUME II